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research, education and conservation

The goals of Canadian Biodiversity are to:

* ***Publish articles, views and news on biodiversity***

* ***Bridge the gaps between professional disciplines & the public***

* ***Communicate information on Canadian & world biodiversity***

* ***Express views on the needs & value of biodiversity research***

* ***Discuss methods and philosophy of biodiversity conservation***

* ***Review books and major articles on biodiversity***

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Dr. Don E. McAllister, Scientific Editor
Canadian Centre of Biodiversity
Canadian Museum of Nature
P.O. Box 3443, Station D
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Fax: (613) 990-8818; Telephone: (613) 990-8819

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EARTH SUMMIT EDITORIAL

Approaching the Earth Summit: The development of the biodiversity agenda

Maurice F. Strong, Secretary-General
United Nations Conference on Environment and Development
160 Route de Florissant, P.O. Box: 80, CH-1231 Conches
Switzerland

One of the key issues for the United Nations Conference on Environment and Development - the first-ever "Earth Summit" - is the conservation of biological diversity. This will provide the strongest possible evidence that biodiversity has at last taken its rightful place in the mainstream of global politics. It can only come as good news to those - like me - who are deeply concerned at the continuing loss of life forms on our planet which is taking place under our very noses. This not only robs us of a cherished natural resource, but destroys one of the vital means on which the attainment of sustainable development - and even the very basis of human survival - depends. So there is no single issue where the integration of environment and development - which lies at the heart of the UNCED process - is more important to the achievement of a political consensus which reconciles national and economic interests with the requirements for global environmental protection.

Growing awareness of the role played by biodiversity in maintaining the health and stability of the Earth's environment has not been achieved entirely without cost. It has been accompanied for example by a deepening of sensitivities and concerns, especially among those countries for which biological diversity represents an important economic resource, that their immediate economic interests - perhaps even their sovereignty - might be compromised by measures to preserve biological diversity in the overriding interests of environmental protection. Many of the critically important environmental and developmental functions performed by biodiversity are crucial to the future of our planet as a secure and hospitable home for future generations, but as they are not accorded an economic value they are frequently ignored in policy and decision making. At the global political level, increasing attention is beginning to focus upon the contribution that biodiversity makes to improving human health and welfare through, for example, the derivation of new and improved food crops and the development of pharmaceutical products. Human beings also benefit from the use of wild plants and animals for food and shelter and as raw materials for industry and the production of energy.

The harvesting and use of diverse ecosystems for immediate gain needs to be carried out in a sustainable fashion if it is not to result in the net destruction of the resource itself. It can also exact a heavy environmental, as well as economic, cost which can frequently exceed the immediate economic benefits. Nevertheless, the sustainable utilisation of biological resources is not only a valid but frequently a necessary component of development, a point often made especially by countries with extensive virgin forest areas. We need to be clear and realistic about this. Until nations and the people who depend on biological diversity for their economic well-being can see that their economic interests are served by the sustainable development of ecosystems, the accelerated loss of biological diversity seems set to continue.

This is the background against which the chapter on the Conservation of Biological Diversity is being prepared for Agenda 21 --the Plan of Action for the 21st Century-- which is expected to be one of the major

outputs from the Earth Summit.

The document which has been prepared for the fourth session of the UNCED Preparatory Committee, which will meet in New York from 2 March - 3 April, has been carefully designed to mobilise, build upon and coordinate activities currently in hand world-wide, to address the many gaps and weaknesses, and to assist the Preparatory Committee to determine priorities for further work. The UNCED Secretariat is working closely with the Intergovernmental Negotiating Committee for a Convention on Biological Diversity - one of the primary goals of UNCED - to ensure that we complement and reinforce its efforts to complete a convention, which I sincerely hope will be signed at the Rio Conference, and to facilitate its implementation.

The Agenda 21 document will set out the programmatic actions required for conserving and making sustainable use of biodiversity. While these will not be mandatory, they will rather comprise a framework to enable governments, intergovernmental and non-governmental organisations, local communities and people to carry out positive actions in a coherent, coordinated and well focused manner. It is my hope that Governments, with the cooperation of others, would be able to take Agenda 21 and develop its programmatic activities according to their own specific constraints and opportunities using all the tools at their disposal. It is important that this include a Convention on Biological Diversity.

Our planet's dwindling biodiversity needs - and demands - all the help we can mobilise. The UNCED team will continue to work hard to see that everything possible is done to ensure this.

PAPERS

The lesser known and often less appreciated smaller plants, animals and microorganisms often play key ecological roles. ***Mycorrhizas*** *(pronounced MIKO-RIZE-US) are partnerships between fungi and the roots of seed plants. The fungus and plant exchange nutrients with each other. 80% of herbaceous plants and trees depend on mycorrhizas for healthy growth.* ***Canadian Biodiversity*** *endeavors to make such key organisms better known and appreciated, and to encourage study of them. The knowledge is important in conservation and biotechnological uses.*

Fungi: A neglected component of biodiversity crucial to ecosystem function and maintenance

David L. Hawksworth
International Mycological Institute
Kew, Surrey TW9 3AF, UK

INTRODUCTION

Fungi, in common with other microorganism groups, are only exceptionally mentioned, let alone considered in depth, in discussions related to both the extent of biodiversity on Earth, and the maintenance of biodiversity. At a time when the conservation of biodiversity is receiving increased attention from the local to the global level, it is opportune to draw attention to the fungal dimension of biodiversity - its magnitude, significance, and conservation. The importance of fungal diversity is not merely an issue for the tropics, but one of immense relevance to the temperate, boreal and arctic ecosystems of Canada and other cooler climes.

MAGNITUDE

At an estimated 1.5 million species, the number of fungi in the world (including lichen-forming species, myxomycetes, oomycetes, and yeasts), may well be second only to the insects (with the possible exception of the unquantified "unculturable" bacteria). This 1.5 million figure was based on extrapolations from the numbers of vascular plants and fungi occurring in the same well-studied geographical area (the British Isles), the number of fungi obligately associated with particular well-studied host plants, and information from an intensively investigated alpine community. After making allowances from unstudied substrates and pleomorphisms, in each case a vascular plant:fungus ratio of about 1:6 resulted. Assuming this ratio holds on a world scale and that there are 270,000 vascular plant species, a 1.5 million figure for the world's fungi emerges (Hawksworth 1991).

This 1.5 million figure is considered conservative as: (a) a world total of 270,000 vascular plant species was used (published estimates are up to 400,000); (b) no special allowance was made for fungi occurring on the vast numbers of insects now estimated to occur (if a mere 5% of the lowest estimate of 5 million insects is taken, that would yield an extra 250,000); (c) the U.K is still far from completely known mycologically (at the current rate of new discoveries, the ratio can be expected to be 1:7 by the year 2000 AD, and 1:8 by 2020 AD; and (d) higher ratios might occur in the tropics, and definitely occur in polar regions.

May (1991) correctly pointed out the need for critical comparative studies of ratios between fungi and vascular plants in particular tropical areas to test whether the 1:6 ratio was applicable in such regions. One case-study has subsequently been brought to my attention. In the Gombe Stream Reserve of the Buha District in Tanzania, Pirozynski (1972) collected 700 species of vascular plants and, from a preliminary sorting of his collections of microfungi, estimated that the species ratio for these was at least 1:3 and perhaps as high as 1:5. Bearing in mind that he did not consider any larger fungi, lichens, yeasts, entomogenous, aquatic or soil species, this suggests that 1:6 may not be

unrealistic for at least one tropical site. Smith and Waller (1992), from their personal experience of plant pathogens in the tropics, suggest that the 1.5 million figure is *too low*, and that there are probably one million undescribed fungi *just* on tropical plants.

EXTENT OF KNOWLEDGE

Whether we are dealing with 1.5 million, or a somewhat greater or lesser number, the extent of our knowledge of the Earth's fungi is minimal. The best estimate of the currently known number of fungal species in the world is a modest 69,000 (Hawksworth 1991). This implies that only about 5% of the world's fungi have yet been recognized. To place this proportion in perspective, there are probably around 5-6 million insect species in the world (Thomas 1990), of which some 800,000, i.e. 13-16%, are described. The extent of our ignorance of the world's fungi is consequently proportionately about three times greater than it is for insects.

In the case of Canada, no comprehensive checklist of the fungi recorded is available. The longest single listing in recent years is that of Ginns (1986), who reported "over 3,000 species" involved in plant diseases or decay in the years 1960-80. However, a conservative estimate of the total number of fungi currently recorded from Canada is 9,600 species, comprising 7,100 non-lichenized (Ginns pers. comm.) and 2,500 lichen-forming species (Brodo 1985). As 3,269 native vascular plants are known from the country (Scoggan 1978), that gives a vascular plant ratio of 1:3. If the 1:6 ratio were taken as an estimate of the total number of fungi to be expected in Canada, that would suggest that about half the species are currently known. Interestingly, that state of knowledge is almost identical to that considered to exist for terrestrial arthropods in Canada, where 33,755 species are known and 32,855 are estimated to be undescribed or unrecorded (Danks 1988).

Up to 80% of the world's vascular plants have mycorrhizal fungal partnerships. The below-ground fungal networks transfer vital nutrients to the plant and receive 15% of the carbohydrates manufactured by tree or other plant, in return.

SIGNIFICANCE IN ECOSYSTEMS

Fungi are important in ecosystem function and the maintenance of biodiversity from the individual organism to the global level. As mutualistic symbionts they are crucial components of lichens and mycorrhizas. Up to 80% of the world's vascular plants are mycorrhizal, the below-ground fungal networks performing vital roles in the absorption of the most limiting nutrients and receiving 15% or more of the carbon fixed by trees in return (Read 1991). In the last 5-7 years it has also become clear that a living aerial parts of many plants consistently have internal "endophytic" fungi, with mutualistic roles documented for those in some cases, for example by imparting insecticidal properties to the plant. Symbioses are also crucially important in the digestive tracts of numerous insects, where they are the source of enzymes enabling them to digest celluloses and lignins (Martin 1987). Novel oomycete anaerobic fungi perform parallel roles in the guts of ruminants, including cattle. The variety and number of examples of coevolution

involving fungi is immense (Pirozynski and Hawksworth 1988).

Fungi are also a major source of food for numerous insects, particularly certain groups of beetles and flies (Hammon and Lawrence 1989). A wide variety of organisms are also dependent on lichenized fungi for camouflage, as in the case of geometrid and psychid moths, and also for food - not least the Canadian caribou during the hard winter months.

Indeed, the lichen-forming fungi are the major to dominant terrestrial life-form over the wide expanses of the Canadian tundra, clothing rocks into the most extreme high Arctic regions. In the taiga and coniferous forest zones, the ectomycorrhizas are vital to the maintenance of the trees. Although many trees can form associations with a wide range of such fungi - in some cases one tree species can forge links with over 100 different fungi - these fungi are essential to the development of those forest types. The variety of the fungi involved imparts some resilience to perturbations to such communities, and no doubt has contributed to their success (Perry *et al.* 1989).

It is not always appreciated that fungi contribute to ecosystem maintenance as biocontrol agents. Plant pathogenic fungi can limit the luxuriance of plants that might otherwise swamp a community, and entomopathogens may limit the populations of insect pests that might otherwise defoliate a dominant tree or otherwise damage key plants in the community. Interestingly, plants introduced from one country to another often behave as pernicious weeds in those countries largely because they were introduced without their associated pests.

Fungi have a major ecological role in the degradation of plant and animal remains, the decomposition of animal faeces, and, through lichens, in rock weathering. In soils, the fungi frequently constitute the major part of the biomass, also contributing both to nutrient cycling and the maintenance of soil structure.

At the global level, the fungi have a major role in the carbon cycle in particular. Substantial but as yet unquantified masses of carbon are trapped in their mycelia below ground and lichens on the surface, and carbon is removed from the atmosphere during rock weathering. Conversely, carbon is returned to the atmosphere during wood decay.

SIGNIFICANCE IN SUSTAINABILITY

Fungi can contribute to sustainability by improving the productivity of existing agriculture and forestry, and by providing novel or alternative products or foodstuffs. They have been used in the production of fermented foodstuffs and beverages for millennia. The further development of factory-base protein production, such as the meat-substitute **Quorn** from a *Fusarium graminearum* strain now on sale in U.K. food stores, and in addition the expansion of the commercial cultivation of a wider range of edible mushrooms, have potential to contribute to a reduction in the demands placed by humans on land.

Increased understanding of micorrhizal species has the potential to increase food and forest production.

Increased understanding of the relative effectiveness of different mycorrhizal species and strains, and further of endophytes, has the potential to improve food production on existing agricultural land.

Fungal inocula are increasingly being developed commercially as biocontrol agents of weeds, fungal diseases, and insect pests. These environmentally-friendly mycoherbicides and mycopesticides are generally target-specific and consequently unlikely to adversely affect non-target crop plants, beneficial insects or humans.

> Fungi are being increasingly used as biological means of controlling weeds, fungal diseases and pests. Many are target-specific, hence environmentally friendly.

A wide and ever increasing range of pharmaceutical products is obtained from fungi, comprising not only such well-known antibiotics as the cephalosporins and penicillins, but wonder-drugs such as cyclosporin, crucial in reducing rejections of transplants in humans. They are also sources of commercial enzymes, organic acids, vitamins, food-colorings, fragrances and perfumes. A beauty of fungal, and other microbial products, is that they can be produced in large vats or fermenters in factories - and so scarcely place pressures on natural ecosystems. The advent of genetic engineering has increased the prospects for such applications dramatically. When a desirable property is discovered, the genes involved can often be cloned and engineered into a yeast or bacterium so that they can be expressed via an organism for which sophisticated fermentation technology already exists.

CONSERVATION

While in general the conservation of a wide variety of habitat types can be expected to safeguard fungi *in situ*, this cannot be assumed to be always effective. Some lichens in particular, once eliminated from old-growth ancient woodland where a continuity of mature trees has not been maintained, fail to re-establish; such species have assisted in the identification of woodlands with long histories of ecological continuity in Europe, and the same principle awaits exploitation in North America (Thomson 1990). Mechanical disturbance of the ground by vehicles, road cuts, or ploughing, disrupts the underground mycelial networks of mycorrhizas.

The greatest threat to fungi in Canada is undoubtedly air pollution in its various guises. Leaf-inhabiting rusts, powdery mildews, tar-spots, and yeasts are susceptible to sulphur dioxide, although it is the lichen-forming fungi that have received most attention and are of particular concern (Hawksworth 1990). Long-term fumigations with sulphur dioxide damages caribou forage lichens (Moser et al. 1980), and these same species have been shown to be susceptible to acid rain at pH 3.0-2.5 (Hutchinson *et al* 1987). Such losses are not only of concern to the survival of caribou and those whose livelihood depends on them, but have major implications for the carbon and water budgets over vast tracts of boreal and Arctic Canada. Lichens are well-established as indicators of air pollution

levels, but have also been shown to be of value as an early warning indicator of forest die-back due to acid rain in Canada (Scott and Hutchinson 1990). Acid rain may be the major cause, directly or indirectly, of the decline of many ectomycorrhizal fungi now well-documented in parts of Europe (Arnolds 1991) - something of major concern for forest health. A parallel phenomenon may be taking place in North America but is difficult to detect in the absence of long-term and wide-scale fungal recording schemes. [*See* under News section the note on effect of acid rain on mycorrhizal fungi of jack pine. Editor].

Our current level of knowledge is such that it is rarely possible to predict what factors enable a particular fungus to persist in a site, and also what the consequences for other organisms might be if it were lost. Mycological (including lichenological) inputs into multidisciplinary investigations into ecosystem function are required to address such questions.

Culture collections of fungi are equivalent to the botanic gardens and seed banks of botanists. In addition to their role in *ex situ* conservation, culture collections are the mechanism by which fungal diversity is made available for experiment and exploitation. This enabling function is of particular importance as in many groups of fungi, but can be extremely serendipitous and expensive, if not impossible to rely on being able to reisolate a species from nature when required. In Canada there are ten major collections of fungus cultures, mostly complementary rather than duplicatory in their holdings, which collectively maintain around 19,500 strains; data from these collections has been incorporated into a national database (Brewer *et al.* 1992). Around half of the strains held originate from Canadian sources, and perhaps 3,500 species are represented in total.

PROSPECT

In recognition of the neglect accorded to fungi, and other microorganism groups, in discussions of biodiversity and its maintenance, a workshop on "Biodiversity amongst Microorganisms and its Relevance" was convened by the International Union of Biological Sciences (IUBS) and the International Union of Microbiological Societies (IUMS) in Amsterdam on 7-8 September 1991. This workshop is one of the initiatives being taken by the Scientific Committee on Problems of the Environment (SCOPE) in support of UNESCO's Man and the Biosphere (MAB) programme. An action statement, MICROBIAL DIVERSITY 21, was prepared, detailing 14 Actions that could be taken to redress the present situation (Hawksworth and Colwell 1991). It is anticipated that elements from that statement will now be incorporated into both the IUCN/WRI/UNEP "Biodiversity Strategy and Action Plan" and AGENDA 21 being developed for the 1992 United Nations Conference on Environment and Development (UNCED).

ACKNOWLEDGEMENTS

I am indebted to my Canadian colleagues Drs. Irwin M. Brodo, Jim H. Ginns, and Kris A. Pirozynski for assistance in obtaining information included in this contribution.

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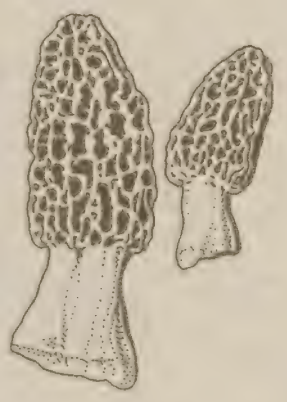

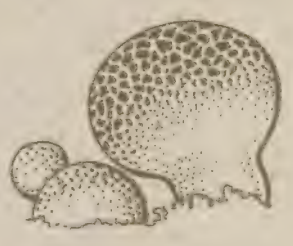

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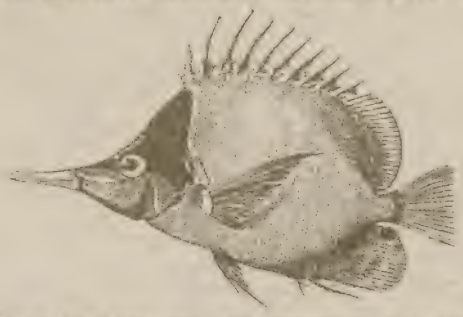
The ocean moderates climate by acting as a heat sink and a carbon sink. Measuring its temperature change on a large-scale is an excellent method of detecting planet-wide climate change. Acoustic temperature measurement of ocean temperature is a very cost-effective method of measuring overall ocean temperature changes.

Global ocean warming



Walter Munk
Scripps Institution of Oceanography
La Jolla, California 92037, U.S.A.

No one really questions that the oceans are an important sink for heat and an important sink for carbon dioxide - $C0_2$. Given the increase in greenhouse gases such as $C0_2$, an earth without oceans would experience atmospheric warming at two or three times the rate than the earth with oceans. What is not so well known is that the oceans are also a sink for ignorance.

Attempts to balance sources and sinks of $C0_2$ go back fifty years. In the 1950's the burning of fossil fuel was estimated to release 6 gigatons of carbon per year (a gigaton is 1,000,000,000 tons). The measured increase in atmospheric $C0_2$ accounted for 4 gigatons per year. To close the budget, the remaining 2 megatons per year were dumped into the oceans: $6 = 4 + 2$. In the 1980's it was realized that the burning of forests constituted an important additional source of 2 gigatons per year; the ocean sink was conveniently doubled: $6 + 2 = 4 + 4$. And during the last few years it has been estimated that the biosphere is also a sink, and the budget now reads $6 + 2 = 4 + 2 + 2$. It is intolerable that $C0_2$ storage in the oceans is estimated by closing a poorly understood budget. Fortunately a program for *measuring* $C0_2$ ocean storage is now underway.

It is equally intolerable that there are no direct measurements of oceanic heat storage. The problem is not simple. Temperature at 1 km depth, say, may vary from month to month by 1°C due to eddies. In the presence of these eddies, it would be almost impossible to detect the effect of greenhouse warming (which I estimate at 0.005°C per year at 1 km depth) from local measurements. But by averaging over many hundreds of such eddies, the eddy fluctuation is greatly suppressed. How is one to measure such averages?

We have proposed an acoustic or sound-based method. There are two circumstances in our favor. The first is that the speed of sound is a sensitive function of temperature, so that the time it takes to send an acoustic pulse from A to B is a function of the mean temperature along the path between A and B. The second is that the oceans provide a channel (like a fiber-optic wave guide) along which sound is

propagated with very small losses.

Last January and February we conducted an experiment to test over what ranges an acoustic source could be heard. Some existing sources were lowered from a vessel into the sound channel to the south of Heard Island in the southern Indian Ocean. The site is unique in that it can "look" along great circles into all of the world's major ocean basins (great circles are the shortest paths between two points on the surface of a sphere). Acoustic receivers were lowered into the sound channel along 15 sites, as shown in the illustration. Clear signals were received at distances up to 16,000 km in the North and South Atlantic, the North and South Pacific, the Indian Ocean and Antarctica. Nine countries participated in the feasibility test.

What is now required is to install a network of sources and receivers at a number of permanent sites, cable-connected to shore, and to monitor the acoustic travel times along many different paths (for more details see Munk and Forbes 1989). I estimate that these travel times will change by something like ¼ second per year due to greenhouse warming, and that it will take about 10 years to detect greenhouse warming over and above changes due to natural ocean variability.

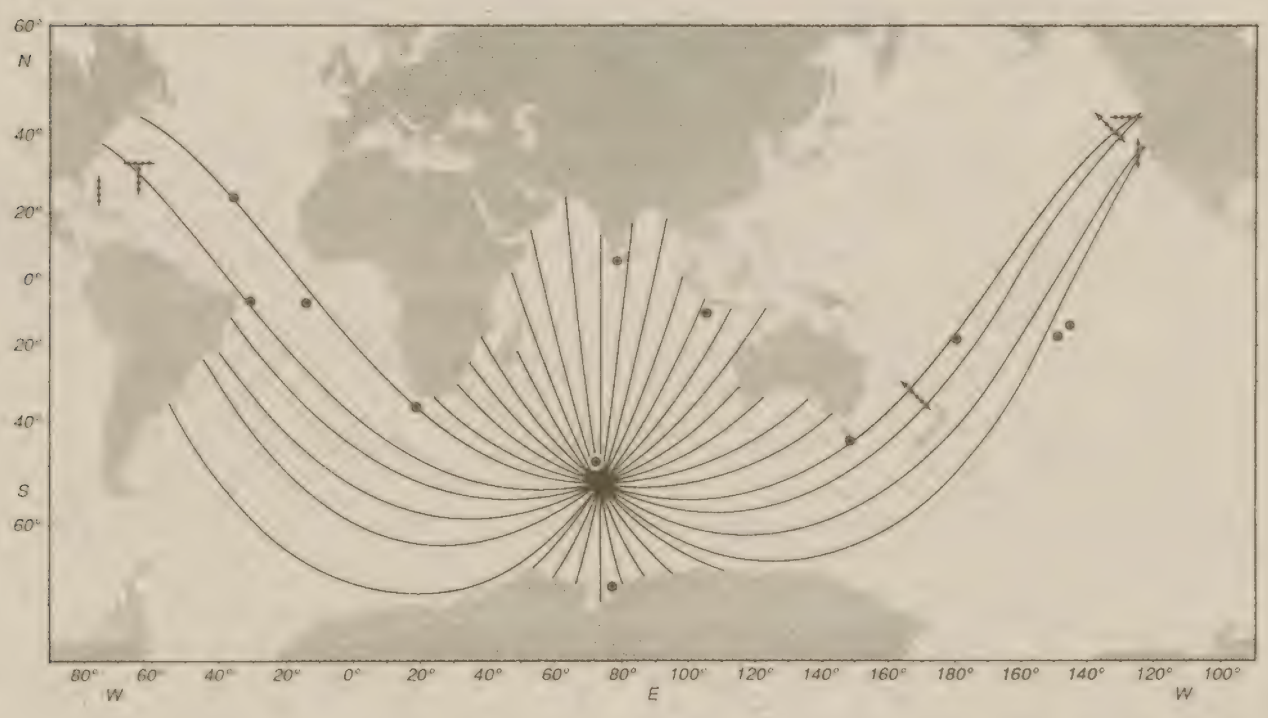


Fig. 1. Rays emanating from a source off Heard Island propagate radially in all directions. The rays shown are nearly great-circles, but they have been corrected for the oblateness (flattening towards the planet's poles) of the Earth and for horizontal refraction arising from gradients in sound speed. Receiving sites are shown by dots and lines. Passage through Tasman Sea north and east of New Zealand was blocked by islands and seamounts.

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Mapping the human and other genomes provides new paths to solving health problems and to new technologies. Participation in this research endeavor will help ensure in sharing the benefits.

The Genome Project: Mapping and sequencing our genes

Phyllis J. McAlpine
Professor of Human Genetics and of Pediatrics
Faculty of Medicine, University of Manitoba
Winnipeg, Manitoba R3E 0W3, Canada

INTRODUCTION

Scientists in most countries of the industrialized world as well as in some of the "eastern bloc" and third world countries are participating in the largest biological endeavour of human history - the mapping of the 50,000 - 100,000 genes, comprised of 3 billion nucleotides and distributed over the 23 pairs of chromosomes in the nucleus of each cell in our bodies. Within the genetic material - the human genome - is the blueprint of the genetic information which specifies that we will be a human and not a cow, or a cat, or a fruit fly, or a bacterium. In addition, our genome specifies precisely what kind of a human we will be, whether male or female, which diseases or abnormalities, if any, we will have, as well as components of our behaviour. While the environment in which we live can influence the impact that our genes have on us as living organisms, perhaps our genetic makeup is the more significant determinant of our physical, physiological and mental attributes. Although each one of us, with the exception of identical twins, begins our lives with a unique genetic blueprint, we all have the same "generic" genetic information, regardless of the variability among the individual members of the species.

The idea that the human genome could be dissected and all the genes identified and sequenced started to obtain widespread attention in 1985, although human gene mapping was a flourishing, if somewhat specialised, scientific endeavour for at least 15 years prior to that. Now it is the focus of a global enterprise being built on a new level of international cooperation, and when completed, our lives will be changed irreversibly.

HISTORICAL PERSPECTIVE

Human gene mapping had its roots in the early part of this century when E.B. Wilson (1911) recognized that the distinctive pattern of inheritance of colour blindness was consistent with a recessive mutation carried on the X chromosome. For the next 60 years, progress in mapping the human genome was slow, principally due to the limitations of the technology available at that time. Until about 1970, the only way to obtain human gene mapping information was to test family data for the non-independent assortment of genes. The task was monumental as the number of genes identified was limited, usually only one disease-determining gene segregated in any one family and only a few of the known genes showed variation that could be studied in the laboratory. Despite these handicaps, the genes for colour-blindness and haemophilia, both of which are on the X chromosome, were shown to be linked by Bell and Haldane

(1937). In 1954, the Lutheran blood group and secretor status loci were shown to constitute the first autosomal linkage group. It took almost 20 years before the autosome on which they lie was identified as chromosome 19. Over the next 17 years, some additional linkage groups were reported. It was not until 1968 that the Canadians Ying and Ives in Saskatoon were able to assign a gene directly to an autosome when they demonstrated linkage between the Duffy blood group locus and a heterochromatic marker on the long arm of chromosome 1 just below the centromere.

Around 1970, two technological advances were made which proved to give significant impetus to the mapping of human genes. These advances were the development of banding techniques so that individual chromosomes could be recognized, and the development of rodent-human somatic cell hybrids which segregated out human chromosomes. Under appropriate conditions, rodent cells, each with a different partial complement of human chromosomes, could be isolated and tested for the presence and absence of human genes and the presence and absence of human chromosomes. Using this parasexual approach, the phosphoglucomutase 1 (PGM1) locus was assigned to chromosome 1. Mapping human genes using this approach became the focus of a number of laboratories.

Progress was occurring at an unprecedented rate and in 1973, Frank Ruddle organized, under the auspices of the March of Dimes, the First International Workshop on Human Gene Mapping at Yale University. Approximately 50 scientists from around the world including two Canadians, the author and Dr. John L. Hamerton from the University of Manitoba, gathered for two days to report their latest findings. They developed the first consensus of the map of the human genome, a map totally deficient in gene assignments to three autosomes (numbers 3, 8, 9). That group of "gene mappers", together with other interested scientists, met subsequently in 1974 and 1975. In 1977, the international community of "gene mappers" gathered in Winnipeg for the Fourth International Workshop (HGM4), organized by Dr. John Hamerton. Although this meeting had an uncertain beginning because the Canadian airline carriers were on strike, making the arrival of the overseas scientists challenging, it provided the forum with the demonstration that linkage groups in different species had been maintained despite up to millions of years of independent evolution since the separation of the common progenitors.

At HGM6 in 1981, gene mapping data, obtained from the use of recombinant DNA technology was considered for the first time at a Human Gene Mapping Workshop and, since then, the impact of this technology on the mapping of human genes has been dramatic. At HGM11, held in London, United Kingdom, August, 1991, over 2300 genes and related sequences (eg. pseudogenes) which would represent 4-5% of the genes in a 50,000 genome were mapped to human chromosomes. At the same meeting, over 6300 anonymous segments of DNA were also recognised. By now, over 8,500 sites within the human genome have been marked by known genes or cloned segments of DNA. Although the number of assignments of genes and anonymous segments of DNA to specific chromosomes is now substantial, it is still not possible to determine the linear order of genes, or the recombination distances between many of the chromosomes.

WHY A GENOME PROJECT?

Mapping and sequencing the human genome is envisioned as a global enterprise that will last a decade and cost several billion dollars. The data to be collected from this project will provide a fundamental understanding of human development and the evolution of the human species. Complete knowledge of our genome will provide the framework for the diagnosis and treatment of genetic diseases, particularly those for which no specific molecular abnormality has been defined. Already, we have seen this approach. The so-called "reverse genetic" approach, utilised by Lap-Chee Tsui and colleagues at the Hospital for Sick Children, Toronto, and his American collaborators, identified the gene defined by the

mutations that cause cystic fibrosis. While this project will give us a totally new perspective on what it means, biologically, to be a person, carrying out the project will have special industrial and technological spin-offs.

New instrumentation, particularly in the area of automation/robotics, is required for the vast amount of laboratory work needed to carry out this project. The amount of information pertaining to the human genome that will be generated has already spawned a new branch of computerised data handling capabilities. New databases have been designed to store primary data and consensus data currently available, but these may not be adequate for capturing all the information that will become available. Furthermore, new computer capabilities will be required to analyze the data at levels of organization higher than the linear order of genes and their sequence data.

WHERE ARE THE CANADIANS?

In 1989, approximately 35 Canadian scientists and government representatives gathered in Toronto for a meeting to discuss Canadian participation in the Genome Project. The meeting, organized by Dr. Ron Worton, Hospital for Sick Children, Toronto, and Dr. Ford Doolittle, Dalhousie University, sponsored by the Canadian Institute for Advanced Studies, endorsed a Canadian participation. It charged the two organizers, together with J. Friesen, Hospital for Sick Children, and M. Smith, University of British Columbia, to prepare a document defining the Canadian participation for presentation to Government. The document "Mapping and sequencing the human genome: a program for Canada" (See *Canadian Biodiversity* 1(3), "A Canadian Genome Initiative"), was presented to The Honourable William Winegard (Minister, ISTC) in December, 1989. During the summer of 1990 an InterCouncil Genome Advisory Committee was established by the three major Canadian granting agencies: the Medical Research Council, (MRC), and Medical Engineering Research (MEC), the Natural Sciences and Engineering Research Council (NSERC) and Social Sciences and Humanities Research Council (SSHRC), and was charged with the mandate of defining a Canadian role in the Genome Project. The committee, composed of 10 scientists and one lawyer under the chairmanship of Dr. Charles Scriver, McGill University, reported (May, 1991) their recommendations to MRC, the agency assuming leadership in this area. The scientific community now awaits the decision of these agencies. The Scriver Committee is recommending that the Canadian Program should complement existing international programs while building on Canadian strengths. This means that the Canadian Program should focus on the targeted organisms identified intentionally such as the human, mouse, yeast, nematode and *Arabidopsis* (a cress). *Drosophila*, bacteria and other species have also been targeted organisms in some national initiatives. Given that genome organization is a fundamental characteristic of every organism, scientists would like to have the genome of every species analyzed in detail. However, the costs of such an analysis is staggering and, hence, a limited number of species has been targeted for detailed analysis. Some species with comparatively

simple genomes such as those of mouse and human have been included in this list because their analysis will be a proto-type for analyzing complex genomes. These two species are included because the conservation of their linkage groups lends itself well to "cross-over" of mapping strategies and analyses. While some individuals are likely to be disappointed that their favourite species is not on the target list, they might be comforted by knowing that synergistic effects of several individuals working on the same project have already been realized.

Several genome projects are now active in other countries around the world. The Americans, the United Kingdom, the European Economic Community, Japan, and the Commonwealth of Independent States all have genome projects, coordinated projects for the systematic gathering of information on the sequence of genomes and the mapping of genomes. Already under-industrialised countries are investigating how they may participate and reap the benefits of the global initiative.

When viewed globally, the Genome Project is certainly big science in terms of the numbers of people involved and in terms of money. For 1991, the American National Institutes of Health has a budget of $87.5 million and the Department of Energy, a budget of $47.4 million committed to this endeavour. In addition, the Howard Hughes Medical Institute, a private organization, also makes a substantial contribution to the American Genome Project, and provides some funds for research in Canada. The U.K. Human Genome Project has a special allocation of £11 million over 3 years (1989-91) and £4.6 million per annum thereafter. The EEC has allocated $15 million ECU over 2 years with the possibility of extending the funding. Italy has had a Genome Project funded at $1.3 million per annum since 1987 by the Italian National Research Council. In Japan, several government agencies are providing financial support to genome related projects.

CANADIANS IN THE GENE MAPPING SCENE

Although Canada is yet to announce a Genome Project, a number of Canadians have been making substantial contributions to the development of the human gene map. At the Human Gene Mapping Workshops Dr. Nancy Simpson, Queen's University, chairs the Chromosome 10 committee. Dr. Diane W. Cox and Dr. Lap-Chee Tsui, Hospital for Sick Children, chair the Chromosome 14 and Chromosome 7 Committees, respectively. Dr. Leigh Field, University of Calgary, is Co-Chair of the Chromosome 6 Committee and the author chairs the Nomenclature Committee. These scientists, in addition to Dr. Marion Lewis and Dr. John Hamerton, University of Manitoba, Dr. Charles Scriver and Dr. Webster Cavanee, McGill University, and Dr. Ron Worton, Hospital for Sick Children are also members of HUGO, the international Human Genome organization. Dr. Worton and Dr. Cavanee were both present at the founding meeting of HUGO and Dr. Worton has since been a member of the HUGO Council.

Many other Canadians are involved in genome analysis research but space precludes listing each of these individuals and their areas of expertise. When there is finally a call for a research proposal pertaining to gene mapping, the Canadian gene mappers will identify themselves.

About the Author

P. McAlpine is a Professor of Human Genetics and of Paediatrics at the University of Manitoba. Her participation in the global project has been funded by the Howard Hughes Medical Institute directly and indirectly through the Genome Data Base at Johns Hopkins University. Her personal research involves the analysis of chromosome 3 (funded by Medical Research Council of Canada) and the mapping of Charcot-Marie-Tooth mutations (funded by the Muscular Dystrophy Association of Canada).

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That only 5% of the world's species are scientifically described and named, hampers ecological study, conservation, wise and innovative utilization. New programs for biosystematic support are therefore needed. There are lessons to be learned from the NSF program.

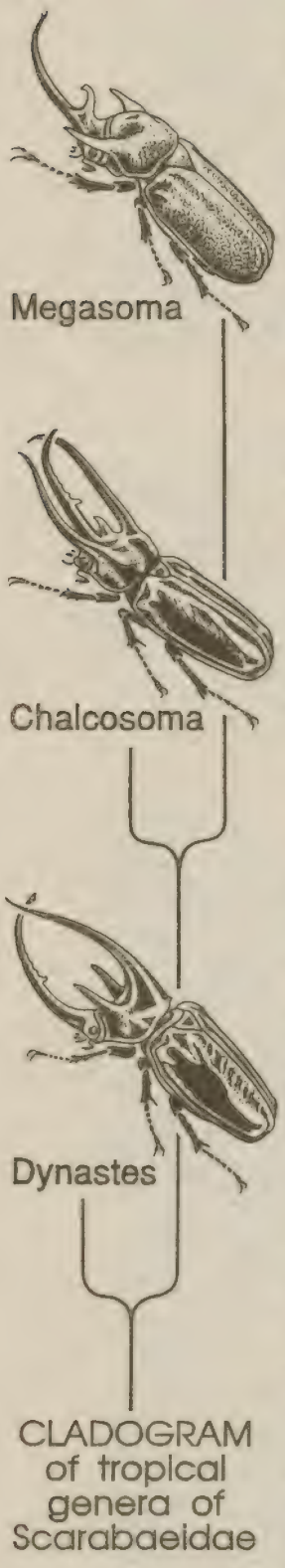
Support for biodiversity research at the National Science Foundation

Terry L. Yates and James R. Estes
Systematic Biology Program
National Science Foundation
1800 G Street NW
Washington, D.C. 20550, U.S.A.

Variation and diversity are essential elements in the maintenance of populations, species, communities, ecosystems and the entire biosphere. The natural complexity of biological systems serves as a buffer against dramatic change, as well as maintaining the necessary ingredients for life. This diversity also plays a significant role in the affairs of our species, as we extract foods, medicines, fibers, and fuels from plants, animals, and microbes. However, the level of diversity for many important groups of organisms are unknown and the mechanisms that sustain many important groups of organisms remain problematic. As expressed in a recent report to the United States National Science Board (Loss of Biological Diversity): A global crisis requiring international solutions, NSB 89-171), "Understanding and maintaining biological diversity is the key to humanity's continued prosperous and stable existence on Earth."

The National Science Foundation (NSF) is committed to continuing the study of biodiversity and its conservation by supporting research that focuses on the survey and inventory of the world's biota, the origin and phyletic history of taxa, adaptation and change within populations, differentiation of communities and ecosystems, and variation within metabolic and physiological processes and pathways.

Research in Biological Diversity receives funding from a large number and wide variety of core programs throughout the NSF. The majority of support, however, is centered in the Directorate for Biological, Behavioral, and Social Sciences (BBS), especially in the Division of Biotic Systems and Resources (BSR). All five core programs in BSR (Systematic Biology, Ecology, Population Biology and Physiological Ecology, Ecosystem Studies, and Biological Research Resources) fund research in biodiversity. Other NSF



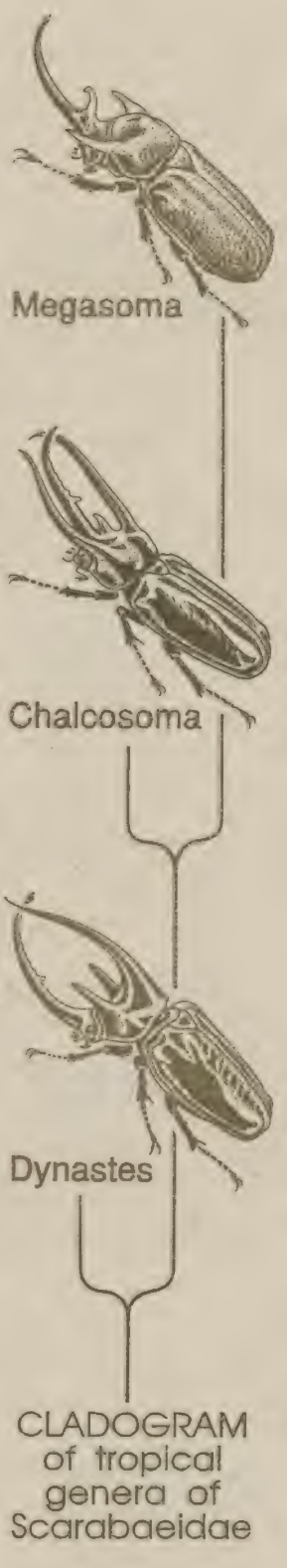
programs (but not all) with a substantial interest in biodiversity are Anthropology; Biological Oceanography; Genetics; Cellular Biochemistry; Biological Basis of Behavior; Geography and Regional Science; Economics; Studies in Science and Technology in Society; Physiological Processes; Mathematics; and International Programs. Therefore, if you have questions concerning the submission of particular research on biodiversity, you should refer to appropriate NSF literature and/or contact a program officer in the appropriate discipline to determine the relevance of your potential research.

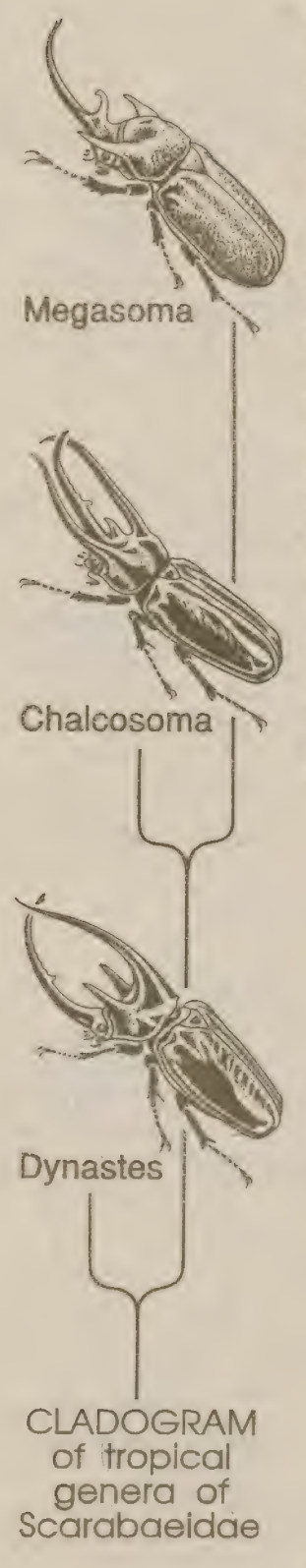
Currently most species-level research in biodiversity is funded through the Systematic Biology Program. This program supports the collection of samples of populations and taxa, characterization and circumscription of taxa, determination of patterns of relatedness and distribution, and application of those inferred patterns to general problems in systematic and evolutionary biology. Systematic biology is also the only current NSF program with a panel devoted exclusively to research in biodiversity - the Biotic Survey and Inventory research competition. (This competition is described below and in the flyer *NSF's Systematic Biology Program Announces Panel for Survey and Inventory Proposals*). This competition provides research support for research that results in the in-depth description of biota of defined regions.

In addition, NSF funds research in Conservation and Restoration Biology, which has its own special competition. Information for this element is also described below.

SURVEY AND INVENTORY RESEARCH

Survey and Inventory Research is primarily devoted to the construction of a foundation upon which other levels of synthesis will be based, but may also generate models and hypotheses concerning biogeography, phylogeny, and speciation. These efforts may involve collecting expeditions or inventories of existing collections as well as museum and laboratory work. The final results of this research may be expressed in various catalogs, databases, floral or faunal inventories, identification manuals, and taxonomic keys. These publications may be based on electronic retrieval or expert system software or printed in a more traditional format. In general to be successful, investigators should anticipate developing an electronic database with broad application, collecting materials with utility beyond that of a simple record of the specimens, having a realistic schedule of work, and focusing beyond the final product of the survey. Priorities and guidelines for this competition were developed through extensive consultation with and review from the scientific community. The criteria used in merit review include: (1) taxonomic breadth, 2) broad geographic scale, (3) urgency for prevention of loss of diversity, (4) a sound management plan, and (5) conceptual or contextual issues. Additional levels of pattern analysis or aspects that focus on human dimensions or other biological processes may be included as a "value-added" component of the proposed survey or inventory, and proposals that include a meritorious value-added component will be favored in the competition. Proposals will be considered by the Survey and Inventory Panel in February of each year. The target date for receipt of proposals is October 15th of each year. (Also see the NSF publication "NSF's Systematic Biology Announces Panel for Survey and Inventory Proposals" for more information.





BASIC RESEARCH IN CONSERVATION AND RESTORATION BIOLOGY

NSF hosts a special competition aimed at elucidating principles that underlie the conservation and restoration of biological diversity. Proposed research may be at any level of the biological hierarchy, from molecular interactions to the biosphere, including human dimensions of conservation. Areas of research that are appropriate for this competition include, but are not restricted to, naturally occurring ecosystems, communities, species, and populations; behavioral and physiological processes of naturally occurring organisms; and the human activities that affect them. Thus, the proposed research may address conservation and restoration issues that affect any level of evolutionary, ecological, or physiological analysis or that integrate research perspectives, but should go beyond individual species concerns. The proposals must be written for one of the participating programs in Biotic Systems and Resources (BSR), Behavioral and Neural Sciences (BNS), Cellular Biosciences (DCB), Molecular Biosciences (DMB), or Social and Economic Sciences (SES). However, they must deal specifically and explicitly with research topics that are fundamental to Conservation Research and must include a section entitled "Relation of the Proposed Research to Conservation or Restoration Biology" as the first part of the body of the proposal. The programs will not accept proposals for this competition that deal with (1) technology of germplasm preservation, (2) management as the primary emphasis, (3) mitigation of environmental disturbances, (4) veterinary medicine, or (5) acquisition of real estate or renovation or construction of facilities. The target date for receipt of proposals is September 29th of each year. (Also see NSF publication 90-66, "Basic research in Conservation and Restoration Biology" for more information.)

NSF supports collection of scientific specimens for systematic study in the poorly known but species-rich areas of the tropics. This photo shows collection of botanical specimens in Madagascar.

SCIENCE IN DEVELOPING COUNTRIES (SDC)

NSF's International Programs (INT) Division makes small grants that are intended both to advance the international exchange of scientific knowledge and to contribute to the scientific infrastructure of developing countries. Because levels of biological diversity in developing countries are often high, because this diversity is under immense pressure resulting from economic exigencies, and because these floras and faunas are so vital to global climate change and atmospheric levels of CO_2 and O_2 and to the global economy, scientists from the U.S. may wish to cooperate with institutions and scientists from particular countries in order to study biological diversity and conservation in those countries. SDC grants may provide funds for the U.S. scientists to visit the host country to plan collaborative research. Proposals relevant to the capacity of the developing country to train scientists in conservation are especially sought. Grants are made to U.S. institutions, but the projects may involve activities at foreign sites. When appropriate, project budgets may include partial payment of support costs of foreign scientists. Individuals from foreign institutions should participate at all levels of the research program including planning, implementation, conduct, and completion of the research. Individuals interested in seeking funding from SDC should contact a program officer at INT for specific information concerning eligible countries and funding possibilities. The target date for submission of proposals is September of each year.

Information about specific NSF programs and contacts is generally available from institutional sponsored-research offices, or may be found in *Education in Science and Engineering; NSF Guide to Programs*; and the monthly *NSF Bulletin*. Single copies of any of the above are available by writing: Forms and Publications Unit, Room 232, NSF, Washington, D.C. 20550, U.S.A. To order by electronic mail, address requests (on BITNET) to pubs@nsf or (on INTERNET) to pubs@ NOTE.NSF.GOV. Please specify publication number, title and your complete mailing address. It should be noted that these competitions are open only to scientists at U.S. institutions, although collaborative participation of foreign scientists is possible under a variety of conditions.

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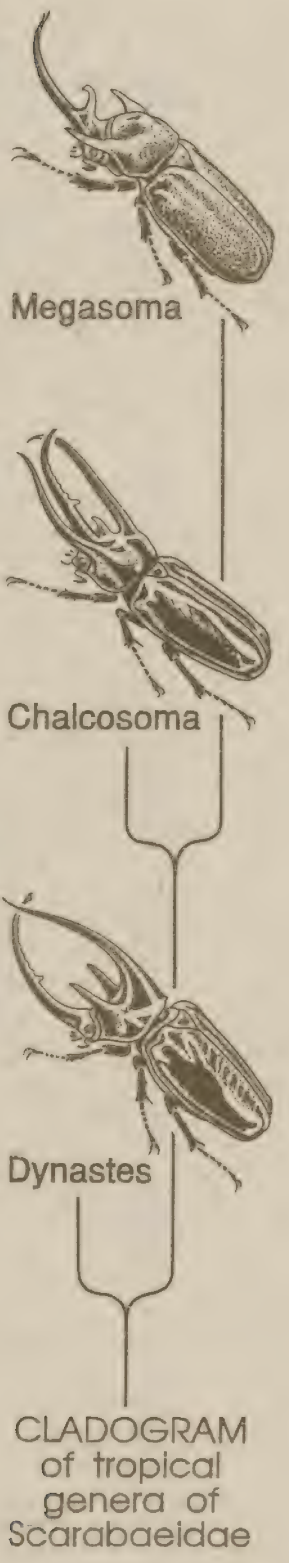


CLADOGRAM of tropical genera of Scarabaeidae

A new guide to 20,000 species of vascular plants, mosses and liverworts of North America, will cover nearly 10% of the world's known species.

The Flora of North America Project

Erich Haber
Collections and Research Branch
Canadian Museum of Nature
P.O. Box 3443, Station D
Ottawa, Ontario K1P 6P4, Canada

HISTORY

The first attempt to compile a flora for North America began with the 1814 publication of Frederick Pursh's *Flora Americae Septentrionalis*. Nearly a century later, the New York Botanical Garden began publishing a series of fascicles, issued sporadically, of detailed treatments of plant families and groups (including fungi and algae) for North American, including Central America.

It was not until the mid 1960's that renewed interest in producing a comprehensive modern treatment of all North American vascular plants, spurred on by news of the compilation of the first volume of *Flora Europaea*, led to a feasibility study by American and Canadian botanists for preparing a Flora of North America. Limited funding in the early years provided the resources for initiating pilot projects, but sufficient, on-going support was not forthcoming. It was not until 1983 when the Missouri Botanical Garden offered to serve as the organizational center for a revised proposal, that the current Flora of North America Project began to take shape. The first sizable grant to the Project was provided by the J.N. Pew, Jr., Charitable Trust. This funding covered administrative costs and the publication and mailing of a Newsletter on floristic work being done in North America. A National Science Foundation grant followed in 1987. This provided matching funding for a supplementary grant from the Pew Trust and support for the production of the first volumes of the 12 volume compendium to be published by Oxford University Press, New York. In 1991, an additional volume was added to include bryophytes (mosses and liverworts).

The project is supported by more than 20 major botanical institutions in the United States and Canada. It is guided by the convening editor, Dr. Nancy Morin of the Missouri Botanical Garden and an editorial committee of plant systematists. The projected cost is about $1 million per year over the next 12 years.

2. Laportea canadensis (Linnaeus) Weddell, Ann. Sci. Nat. Bot., sér. 4. 1: 181. 1854 - Wood-nettle

Urtica canadensis Linnaeus, Sp. Pl. 2: 985. 1753; Urticastrum divaricatum (Linnaeus) Kuntze

Annual or perennial rhizomatous herbs with tuberous roots, 3--15 dm, sparsely to densely covered with stinging hairs and nonglandular, nonstinging hairs. **Leaf blades** narrowly to broadly ovate, 6--30 X 3--18 cm, base rounded to broadly cuneate, not auriculate, apex acuminate, margin regularly serrate. **Inflorescences** unisexual, the proximal staminate, the distal pistillate. **Staminate flowers** ca. 1--1.5 mm across; tepals 5, equal in length; stamens 5, opposite the tepals, filaments slightly longer than the tepals. **Pistillate flowers** ca. 0.5 mm, tepals 2 or 4, appressed, the inner pair as long as the ovary; ovaries compressed, semicircular to crescent-shaped; styles elongate, feathery, 2--3 mm or more, persistent. **Achenes** strongly compressed, circular or semicircular, ca. 2--3 mm across, the pedicels winged. 2n = 26 [I. J. Bassett et al. 1974]

Flowering spring--early fall. Rich, moist, deciduous forests, often along seepages and streams; 0--2000 m; Alta., Man., N.B., Nfld., N.S., Ont., Que.; all states except Alaska, Ariz., Calif., Colo., Idaho, Mont., Nev., N.Mex., Oreg., Tex., Utah, Wash., Wyo.; Mexico.

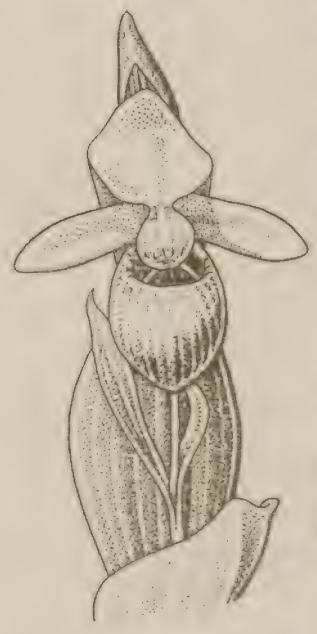
Laportea canadensis

Figure 1. Example of a plant description and distribution map from the Flora of North America, Guide to Contributors.

GENERAL DESCRIPTION OF THE FLORA & METHODOLOGY

The flora will contain names, synoptic descriptions, identification keys and distribution maps for roughly 20,000 species of vascular plants and bryophytes occurring without cultivation in the continental United States, Canada, Greenland and St. Pierre and Miquelon Islands. Important diagnostic features will be illustrated as will representative or unusual species. The overall arrangement of the vascular plant families will be that of Cronquist (1981) in *An integrated system of classification of flowering plants*. If no systematic arrangement is possible within the group, the taxa will be arranged alphabetically. Numerous specialists will write the treatments for the groups with which they are most familiar so that the most up-to-date information will be included. These treatments will undergo review by other specialists and by members of the editorial committee. For those groups where no specialists are available, the project will support the writing of treatments by staff botanists and recent Ph.D.s. The Flora of North America Project is also collaborating with the organizers of the Grass Manual Project whose aim is to revise the standard reference work for agrostologists, the *Manual of grasses of the United States* by Hitchcock (1950). In so doing, contributors for the grass manual will also be able to submit the same treatments for the Flora of North America, thereby maintaining a uniformity in treatment for grasses in both publications.

As part of the overall documentation for the Flora, a computerized database is being compiled to include information on the names of plants, literature citations, descriptions, distributions, status of threatened and endangered species and supplementary facts, as available, on chromosome numbers, ecology, chemistry, reproductive biology and uses. Such a comprehensive database will allow for a wide variety of database searches and uses. Some potential uses might include the compilation of state and provincial checklists, the listing of introduced taxa and the identification of endemics or species found in various habitat types. In conjunction with this floristic database at the Missouri Botanical Gardens, a comprehensive bibliographic database is also being established at the Hunt Institute for Botanical Documentation.



PRESENT STATUS AND SUMMARY

Publication of the first volume on ferns, fern allies and gymnosperms, in 1991, appears to be virtually on schedule. Introductory chapters of this volume will include topics such as the vegetation, climate, soils and geological history of North America. Treatments for volume two are also well under way.

The publication of a Flora of North America is a colossal venture. It is a costly undertaking both in terms of finances and professional commitments by contributors and editors. If the aims of the organizers are met, the benefits, in the long run, will far outweigh the costs. The Flora will be the first compendium of all vascular plants and bryophytes in North America. Together with its computer database, it will serve as the basic inventory for North American vascular plants and bryophytes and as a reference work for up-to-date plant names, descriptions, distributions and supplementary biological and conservation-related information for generations to come.

[Prepared from literature provided by the Missouri Botanical Garden].

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Hitchcock, A.S. 1950. Manual of the grasses of the United States. 2nd edition, revised by Agnes Chase. Government Printing Office, Washington, D.C. 1051 pp.

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Committee on the Status of Endangered Wildlife in Canada - COSEWIC

W.T. Munro, R.P. Bio.
Chairperson, COSEWIC
Wildlife Branch
B.C. Environment
Victoria, B.C. V8V 1X5

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was formed in 1977 as a result of a recommendation of the Federal-Provincial Wildlife Conference. It arose from the need for a single official, scientifically sound national listing of wild species at risk in Canada. Its mandate is to determine the status at the national level, of wild species, sub-species and separate populations in Canada. All native vascular plants and animals except invertebrates, are included.

COSEWIC consists of one representative from the wildlife agency of each province or territory, one from each of four federal agencies (Canadian Wildlife Service, Canadian Museum of Nature, Department of Fisheries and Oceans, Parks Canada), and one from each of three nationally-based private conservation agencies (Canadian Nature Federation, Canadian Wildlife Federation, World Wildlife Fund Canada). The Committee elects its own chairperson for a two year term. In addition to the above, COSEWIC includes sub-committee chairpersons responsible for work on biological groups (birds, terrestrial mammals, fish and marine mammals, amphibians and reptiles, plants).

Sub-committees are the organizational units of COSEWIC responsible for obtaining, reviewing the quality of, and presenting status reports upon which all status determinations are based. The sub-committee chairpersons are chosen for their scientific knowledge to be expert advisors to COSEWIC in their field. They are proposed by the COSEWIC chairperson and confirmed by all members at the next annual meeting. Sub-committee chairpersons choose and recruit sub-committee members who are experts in the field of the sub-committee.

The purpose of sub-committees is to obtain and present status reports at general meetings. Status reports may be provided by COSEWIC member jurisdictions, individuals or obtained by COSEWIC through contract. Sub-committees ensure scientific quality, propose an appropriate national status, and present status reports to the membership for formal assignment of status.

Status reports are the instruments of status determination. Each report is an up-to-date description of the distribution, abundance and population trends of a species. COSEWIC meets annually in April to declare official status for all species for which status reports have been prepared and circulated.

COSEWIC recognizes five risk categories: vulnerable, threatened, endangered, extirpated and extinct. Definitions of those categories are in Appendix 1. Sometimes a status report is reviewed and the species determined not to be at risk. In those cases the committee classifies it as report accepted - no designation required.

Since its inception, COSEWIC has evaluated 276 species. For 64 species, it found no designation was required. The remaining 212 species were classified as follows:

Category (Status)	Birds	Mammals (Terrs)	Mammals (Marine)	Fish	Vascular Plants	Amphi-bians & Reptiles	TOTAL
Vulnerable	17	15	4	34	21	6	97
Threatened	8	5	3	10	22	2	50
Endangered	9	5	6	3	19	4	46
Extirpated	1	3	2	2	2	-	10
Extinct	3	1	1	4	-	-	9
TOTALS	38	29	16	53	64	12	212

The status of each species listing is not permanent, as it based on the best information available at the time of study. It may be reviewed whenever new information is presented. It is possible to re-designate a species into a more critical category should its prospects for continued survival deteriorate, or to a less critical category when risks diminish. Examples of criteria used for determining status are in Appendix II.

The findings of COSEWIC are published in the form of detailed status reports which are sold through the Canadian Nature Federation in Ottawa. Recent ones have been published by the Canadian Field-Naturalist. Following each annual meeting, a news release is issued listing new designations. Up-to-date lists of all species evaluated and designations assigned are available annually from the COSEWIC Secretariat. Designations of species that occur in B.C. are in Appendix III.

It should be emphasized that COSEWIC is concerned only with drawing official attention to the possible loss of wild species that have historically maintained populations in Canada. It is not mandated to take any action which would alter the fortunes of species beyond establishing status and publishing the information on which status is based. There are no legal consequences or requirements following declaration of status. The purpose of COSEWIC and of declaring status is to provide a national scientific consensus which optionally may or may not be used by jurisdictions in the exercise of their mandates.

APPENDIX 1

DEFINITIONS OF CONSERVATION STATUS

Species:	"Species" means any species, subspecies or geographically separate population.
Vulnerable:	Any indigenous species of fauna or flora that is particularly at risk because of low or declining numbers, occurrence at the fringe of its range or in restricted areas, or for some other reason, but is not a threatened species.
Threatened Species:	Any indigenous species of fauna or flora that is likely to become endangered in Canada if the factors affecting its vulnerability do not become reversed.
Endangered Species:	Any indigenous species of fauna or flora that is threatened with imminent extinction or extirpation throughout all or a significant portion of its Canada range.
Extirpated Species:	Any indigenous species of fauna or flora no longer existing in the wild in Canada but occurring elsewhere.
Extinct Species:	Any species of fauna or flora formerly indigenous to Canada but no longer existing anywhere.

APPENDIX II

EXAMPLES OF CRITERIA FOR CHANGING STATUS OF COSEWIC SPECIES

	DOWNLISTING	UPLISTING
Extirpated	a) Species, subspecies or population is successfully reproducing at the F_2 generation in free-ranging or fenced conditions.	a) No record for 3-5 years of individuals or populations in suitable habitat in spite of investigation.
To	b) Survival of offspring to reproductive age is greater than mortality over that time period.	
Endangered	c) Habitat essential to species' survival is adequately protected in the foreseeable future (30 years) through management or preservation.	
	d) Population is stable, or increasing but numbers still very small.	

	e) A backup source of breeding age individuals is available in Canada (captive, cultivated or wild individuals from another country).	
Endangered	a) At least 3 populations separated spatially by some considerable distance. b) All sites are adequately protected and regulated areas. c) Most or all populations are showing significant increase with natural expansion of range occurring, or all existing habitat at site is occupied.	a) Very few native populations exist (perhaps 3 or less remaining, protected or not). Populations are declining drastically due to habitat loss, excessive harvest, natural catastrophes, environmental stresses other factors caused by man.
To	d) Habitat, in addition to that currently occupied, is available for continued range expansion. e) Threat is still evident in part of most of species' former range in Canada.	
Threatened	f) Captive or cultivated stock for wild release maintained if needed.	

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CITES is one of the world conventions that helps conserve rare and endangered species. It regulates those species that enter into international trade.

Convention on International Trade in Endangered Species of Wild Fauna and Flora - CITES

Robert R. Campbell
CITES, Canadian Wildlife Service
Environment Canada
Ottawa, Ontario
K1A 0H3

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an agreement to regulate the international movement of specific species of wild animals and plants as well as their respective parts and derivatives. The need for international co-operation to eliminate trade in illegally obtained animals and plants has existed for many years and is of great concern to developing nations in Africa, South America and the Far East.

The need for such an agreement was discussed at the 1972 Stockholm Conference on the human Environment. At that Conference, it was recommended "that a plenipotentiary conference be convened as soon as possible, under appropriate governmental or intergovernmental auspices, to prepare and

adopt a convention on export, import and transit of certain species of wild animals and plants".

The Government of the United States of America called the 1973 Washington Conference which resulted in the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

After intensive discussions with federal departments (Fisheries and Oceans, Indian Affairs, Customs and Excise and Industry, Trade and Commerce [now part of External Affairs]) in May 1974, Cabinet agreed that Canada proceed to ratify the Convention. Environment Canada was designated as both the Management Authority and the Scientific Authority for purposes of CITES in Canada. After ratification on April 10, 1975, the Convention became applicable in Canada effective July 3, 1975. As a result of the ratification by ten nations by April 7, 1975, the Convention became applicable to those countries, and internationally, on July 1, 1975. These Management and Scientific responsibilities were then delegated to the Canadian Wildlife Service.

As of August 1, 1989, 110 nations have ratified or acceded to the Convention. The Convention regulates the international movement of over 48,000 species of wild animals and plants, as well as their respective parts and derivatives, that are listed in three Appendices.

Appendix I species are rare or endangered and trade will not be allowed for primarily commercial purposes. Before trade is commenced, the importer must be in possession of a Convention export permit issued by the government of the exporting nation and an import permit issued by the Canadian Wildlife Service.

Appendix II species are not presently rare or endangered but could become so if trade is not regulated. The species being traded must be covered by an appropriate Convention export permit issued by the government of the exporting nation before entry to Canada will be allowed.

Appendix III species are not endangered but are managed within the listing nation. Permit requirements for Appendix III are as for Appendix II species.

Parties to the Convention meet every two years in order to consider amendments to the Appendices, to discuss and approve the CITES international Secretariat financial budget, and to improve the general administration and enforcement of the Convention.

The Convention is applied in Canada through a General Export Permit and a General Import Permit made in accordance with the Export Regulations and the Import regulations of the Export and Import Permits Act administered by the Department of External Affairs.

The General Export Permit authorizes the Canadian Wildlife Service to issue export permits for species under federal jurisdiction with the exception of those species subject to Fisheries and Oceans Canada jurisdiction. CWS is also authorized to issue all Scientific Certificates and Temporary Export Certificates. Fisheries and Oceans Canada is authorized to issue export permits for species subject to Fisheries and Oceans legislation. The provinces and territories are authorized to issue CITES export permits for species originating in and subject to their respective jurisdictions.

The General Import Permit authorizes the Canadian Wildlife Service to issue CITES import permits, Scientific Certificates and Temporary Import Certificates.

Being an international agreement, the Convention does not apply to the movement of species within Canada.

All forms used are those prescribed by the Export and Import Permits Act.

As the Management Authority for Canada, the Canadian Wildlife Service speaks on behalf of Canada and is responsible for all international and national communications and the application and co-ordination of CITES within Canada. The participation in the application of CITES within Canada by various federal government departments (External Affairs, Customs and Excise, RCMP, Agriculture, Fisheries and Oceans) and by provincial and territorial governments is co-ordinated by a series of Operational Directives issued by the Canadian Wildlife Service. These functions are performed by the Administrator, CITES, within CWS.

The Management Authority is advised by a Scientific Authority, an officer located within CWS, on all CITES scientific matters.

Given the apparent commitment of the Canadian Government to the Convention, Canada's wildlife policy, our commitment to the World Conservation Strategy and "sustainable use" of renewable natural resources, the involvement of at least five federal departments and all provincial/territorial governments, it would seem that Canadian regulation of trade in species of concern to CITES should be straightforward and effective. Yet it is not.

Because of the split of jurisdiction over wildlife in Canada between federal and provincial/territorial governments, and because of the sheer size of Canada, 149 officers have been appointed to issue CITES permits and hundreds of Customs and RCMP officers are equally enforcing the often complex CITES regulations made under the Export and Import Permits Act. As these officers also enforce a multitude of other Acts and Regulations, CITES enforcement is furthermore diluted.

CITES is a relative newcomer to the list of responsibilities; officers have little training and/or knowledge of the requirements, let alone of the species involved (over 48,000 at this time), and often duplicate permitting may apply where Agriculture Canada Health of Plants/Animals Regulations are also required.

This presents few problems where legal imports are involved and all necessary permits are in place, however the situation severely restricts the ability to counteract "illegal" movements, especially where these concern individual items being transported in personal baggage. The problem is compounded by the general lack of knowledge of the public concerning CITES and permit requirements. Conservative estimates suggest that, at best, 10% of the volume in trade is adequately controlled and accounted for.

Currently, steps are being undertaken to improve the implementation and enforcement of CITES in Canada. New legislation expected late in 1991 will mandate enabling legislation and regulations to CWS, exports and imports will only be permitted at designated ports of entry/exit and CWS enforcement personnel will be available to such ports to facilitate identification and control of material of concern to CITES. There remains the larger problem and that is the public education process, not only to increase public awareness of CITES, but also to increase public awareness of the need for the conservation of renewable natural resources to permit sustainable development of renewable resources for the benefit of all Canadians.

VIEWS

Chief Seattle was leader of the Suquamish Tribe in Washington Territory. He was deeply respected by his people and the whites for his great wisdom. Born about 1786, he became a leader of six tribes after successfully repulsing an attack of mountain peoples. In his half century as acknowledged leader, he was known for meting out justice, peace-making, his oratorical skills and resonant voice. Nearly six feet tall in his moccasins, with magnificent bearing, he had natural dignity and grace. He apparently gave a speech in 1854 to mark the conditional transfer of ancestral Indian lands to the United States government, and wrote the following letter to the U.S. president Franklin Pierce in 1855. He died in 1866. The city of Seattle is named in his honor.

His wise words, 137 years old, are even more appropriate today than when he spoke them. For more than anything we need a change in attitude towards life and the planet. Chief Seattle expressed the view that man is a part of the web of life, that the land is sacred, and that "each shining pine needle" is holy. Read it aloud to your family, students and friends.

Earth Wisdom - Chief Seattle's message to the U.S. President. Part 1.

The Great Chief in Washington sends word that he wishes to buy our land.

The Great Chief also sends us words of friendship and goodwill. This is kind of him, since we know he has little need of our friendship in return.

How can you buy or sell the sky, the warmth of the land? The idea is strange to us.

If we do not own the freshness of the air and the sparkle of the water, how can you buy them?

Every part of this earth is sacred to my people. Every shining pine needle, every sandy shore, every mist in the dark woods, every clearing and humming insect is holy in the memory and experience of my people. The sap which courses through the trees carries memories of the red man. We are part of the earth and it is part of us. The perfumed flowers are our sisters; the deer, the horse, the great eagle, these are our brothers. The rocky crests, the juices in the meadows, the body heat of the pony, and man - all belong to the same family.

So when the Great Chief in Washington sends word that he wishes to buy our land, he asks much of us.

The Great Chief sends word he will reserve us a place so that we can live comfortable to ourselves. He will be our father and we will be his children.

So we will consider your offer to buy our land. But it will not be easy. For this land is sacred to us. This shining water that moves in the streams and rivers is not just water, but the blood of our ancestors. If we sell you land, you must remember that it is sacred, and you must teach your children that it is sacred and each ghostly reflection in the clear water of the lakes tells of events and memories in the life of any people. The water's murmur is the voice of my father's father.

Figure 1. Chief Seattle said, "Every shining pine needle, every sandy shore, every mist in the dark woods, every clearing and humming insect is holy in the memory and experience of my people."

The ashes of our fathers are sacred. Their graves are holy ground, and so these hills, these trees, this portion of the earth is consecrated to us. We know that the white man does not understand our ways. One portion of the land is the same to him as the next. The earth is not his brother, but his enemy, and when he has conquered it, he moves on. He leaves his father's graves behind. He does not care. His father's graves and his children's birthright are forgotten. He treats his mother, the earth, and his brother, the sky, as things to be bought, plundered, sold like sheep or bright beads. His appetite will devour the earth and leave behind only a desert.

I do not know. Our ways are different from your ways. The sight of your cities pains the eye of the red man. But perhaps it is because the red man is a savage and does not understand.

There is no quiet place in the white man's cities. No place to hear the unfurling of leaves in spring or the rustle of insect's wings. The clatter only seems to insult the ears. And what is there to life if a man cannot hear the lonely cry of the whippoorwill or the arguments of the frogs around a pond at night? The Indian prefers the soft sound of the wind darting over the face of a pond and the smell of the wind itself, cleansed by a midday rain or scented by a pinion pine.

Man did not weave the web of life; he is merely a strand in it. Whatever he does to the web, he does to himself.

The air is precious to the red man, for all things share the same breath - the beast, the tree, the man, they all share the same breath. The white man does not seem to notice the air he breathes. Like a man dying for many days, he is numb to the stench. But if we sell you our land, you must remember that the air is precious to us, that the air shares its spirit with all the life it supports. The wind that gave our grandfather his first breath also received his last sigh. And the wind must also give our children the spirit of life. And if we sell you our land, you must keep it apart and sacred, as a place where even the white man can go to taste the wind that is sweetened by the meadow's flowers.

So we will consider your offer to buy our land. If we decide to accept, I will make one condition: the white man must treat the beasts of this land as his brothers.

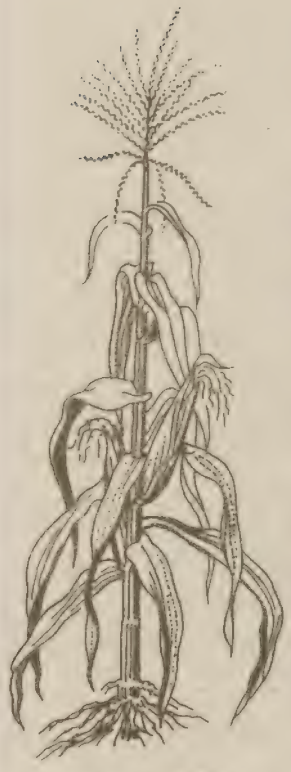
I do not understand any other way. I have seen a thousand rotting buffaloes on the prairie, left by the white man who shot them from a passing train. I do not understand how the smoking iron horse can be more important than the buffalo that we kill only to stay alive.

You must teach your children that the ground beneath their feet is the ashes of our grandfathers. So that they will respect the land, tell your children what we have taught our children, that the earth is our mother. Whatever befalls the earth befalls the sons of earth. If men spit upon the ground, they spit upon themselves.

This we know. The earth does not belong to man; man belongs to the earth. This we know. All things are connected like the blood which unites one family.

Whatever befalls the earth befalls the sons of the earth. Man did not weave the web of life; he is merely a strand in it. Whatever he does to the web, he does to himself.

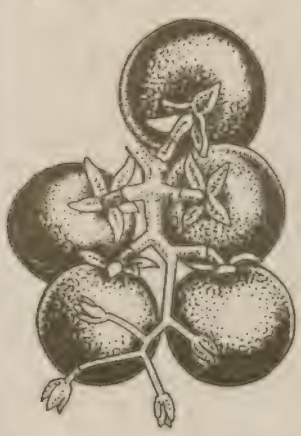
But if we will consider your offer to go to the reservation you have for my people, we will live apart and in peace. It matters little where we spend the rest of our days. Our children have seen their fathers humbled in defeat. Our warriors have felt shame, and after defeat they turn their days in idleness and contaminate their bodies with sweet foods and strong drink. It matters little where we pass the rest of our days. They are not many. A few more hours, a few more winters, and none of the children of the great tribes that once lived on this earth or that roam now in small bands in the woods will be left to morn the graves of a people once as powerful and hopeful as yours. But why should I mourn the passing of my people? Tribes are made of men, nothing more. Men come and go, like waves of the sea.



> This we know. The earth does not belong to man; man belongs to the earth. This we know. All things are connected like the blood which unites one family.

Even the white man, whose God walks and talks with him as friend to friend, cannot be exempt from the common destiny. We may be brothers after all; we shall see. One thing we know, which the white man may one day discover - our God is the same God. You may think now that you own him as you wish to own our land, but you cannot. He is the God of man, and his compassion is equal for the red man and the white. The earth is to heap contempt on its Creator. The whites, too, shall pass, perhaps sooner than all the other tribes.

But in your perishing you will shine brightly, fired by the strength of the God who brought you to this land and for some special purpose gave you dominion over this land and over the red man. That destiny is a mystery to us, for we do not understand when the buffalo are all slaughtered, the wild horses are tamed, the secret corners of the forest heavy with the scent of many men, and the view of the ripe hills blotted by talking wires. Where is the thicket? Gone. Where is the eagle? Gone. And what is it to say good-bye to the swift pony and hunt? The end of living and the beginning of survival.



When the last red man has vanished from this earth, and his memory is only the shadow of a cloud moving across the prairie, these shores and forests will still hold the spirits of my people. For they love this earth as the newborn loves its mother's heartbeat. So if we sell you our land, love it as we've loved it. Care for it as we've cared for it. Hold in you mind the memory of the land as it is when you take it. And with all your strength, with all your mind, with all your heart, preserve it for your children, and love it ... as God loves us all.

One thing we know. Our God is the same God. This earth is precious to him. Even the white man cannot be exempt from the common destiny. We may be brothers after all. We shall see.

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Biodiversity gold - a gift of First Nation North Americans to the planet

Don E. McAllister
Canadian Centre for Biodiversity
Canadian Museum of Nature
P.O. Box 3443, Station D
Ottawa, Ontario K1P 6P4, Canada

and

Peter G. Whiting
637 Fraser Avenue
Ottawa, Ontario
K2A 2R6

First Peoples freely gave a gift to early European immigrants that was more valuable than the gold they thirsted for. This gift has benefited 25 generations of North Americans. It has multiplied and spread to every continent except Antarctica. It is worth billions of dollars every year. The gift includes golden corn, pumpkins, squash, string beans, sunflowers, tomatoes, and potatoes. This gift should be better recognized in our history and text books.

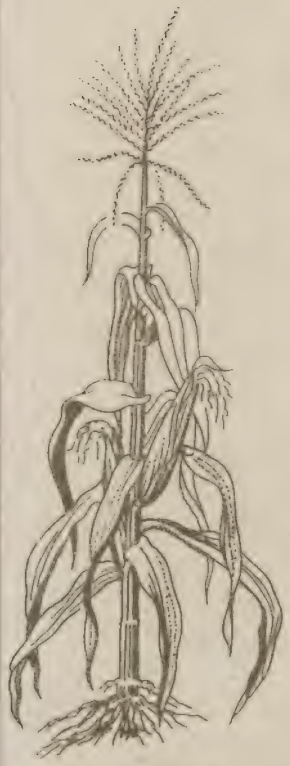
The gift embraced knowledge of methods of culture, including intercropping and organic fertilizers, methods now being reintroduced to modern agriculture. It also included genetic lineages, selected over long periods of time, for yield, nutrition, and for pest resistance.

Corn, *Zea mays*, is an annual member of the grass family, Graminae. Scientific corn breeding, instituted in the early 1900's, is a recent phenomenon compared to First People efforts. First Peoples in Mexico started with an unknown wild grass ancestor, perhaps **Teosinte**, and bred a proto-corn variety with a cob as long as your little finger about 7,000 years ago. Over a period of time they produced improved varieties, ending with a cob, laden with fat kernels, about as long as your forearm. Regional varieties were adapted to culture in southern climes of Central America north to those in the Gaspé Peninsula of Québec. Most of these varieties are now lost, or merged into the 7 main hybrid commercial varieties that supply most of the corn seed in United States and Canada. One or two aboriginal varieties, called "Indian corn" are now grown for the decorative value of their kernels, colored yellow, red, brown, white, black or blue.

Corn is now widely grown around the world and is just behind wheat and rice in world production. In 1981 world grain-corn production peaked at 438 million tonnes. In Europe it is often known as maize to distinguish it from English usage of corn which refers generally to grain or specifically to wheat. In Africa, **mealies** as ears of corn are known, are a standard staple in many countries.

Corn has many uses. It is used for cattle and poultry feed; human food (sweet corn, eaten fresh, frozen or canned); a common source of starch and syrup; the basis for much whisky distilled in the United States; corn oil, frequently used for salads or cooking; pop corn; varieties of paper and insulation.

String beans, *Phaseolus vulgaris*, were observed by Jacques Cartier in 1535 growing in First People gardens of the St. Lawrence Valley. From this progenitor were developed

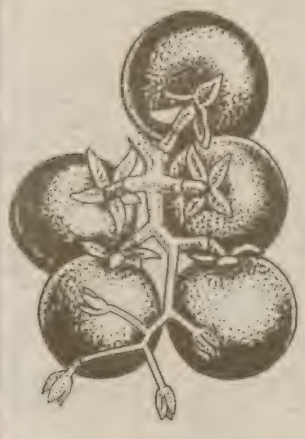


stringless varieties, today's snap beans. As a member of the Leguminosae, the pea family, these plants produce their own nitrogen needs, fostering nitrogen-fixing bacteria in nodules on their roots. As long as beans have been grown in the plot before, they will provide their own nitrogen, otherwise one may have to treat them with a nitrogen-fixing inoculant.

Tomatoes, *Lycopersicon esculentum,* a member of the Nightshade family, were thought by the first European visitors to North America to be poisonous. In Europe tomatoes were first known as "love apples" and propagated as decorative plants. Now they are known as a nutritious (high in vitamins A, thiamine, riboflavin, niacin and ascorbic acid) and delicious vegetable. Tomato cultivation originated in Peru and was used in pre-contact times by the peoples of South and Central America. Nowadays thousands of tonnes are consumed fresh in salads, cooked in pizzas, in ketchup as sauce, and in dozens of other fares.

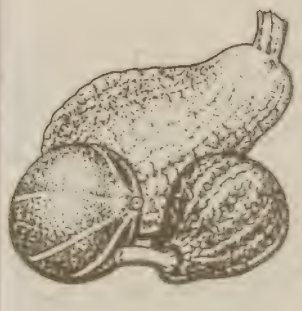
Tobacco, *(Nicotaenia tabacum)*, an annual plant of the Nightshade family, was also a gift of First Peoples to Europeans. Unfortunately Europeans and their marketing system abused this gift, causing disease or death to thousands. For the First Peoples, tobacco was to be smoked, on occasion, for spiritual purposes or for ceremonies such as sanctifying peace agreements. Unfortunately the whites learned neither this moderation, nor how to make peace.

Squash, genus *Cucurbita*, belongs to the Cucurbitaceae family and is native to the New World. Evidence suggests that it may have been domesticated as early as 7,000 B.C. in the Tehuacan Valley of Mexico. Huron peoples in Ontario were cultivating squash by 1400 AD.



Sunflowers, *Helianthus annuus*, belong to the family Compositae, plants with composite flowers. This sturdy plant, up to two metres or more tall, was initially cultivated by First Peoples in Mexico. The seeds are eaten salted or raw - I find them a fine addition to my home-made morning granola. The oil from the seeds is useful on salads and in cooking. The seeds are used by bird-lovers to attract winter birds. The stalks and leaves of sunflowers in some areas are formed into logs for the fireplace.

Today, harvests from First People crop plants feed millions of people and provide input for numerous industries. The value of this golden cornucopia far exceeds the gold after which Columbus and his followers chased. The Canadian farm-gate prices of some crops originally cultivated by aboriginals are as follows, in millions of dollars: animal feed corn $950 (assuming half of animal feed grain is corn); sweet corn $71.4; field and greenhouse tomatoes $132, peppers $17.8, sunflower seeds $22.1, and beans $15.1. (There are many other crops developed by First Peoples that are not listed, e.g. potatoes). This totals about $1.2 billion each year. It does not include retail markups, secondary products enabled (beer, scotch, bread, cakes, beef, poultry), or economic multiplier effects, which would probably triple this amount to about $3 billion per year. In the United States one would expect these benefits to be at least ten times greater, $30 billion per annum, giving a total of $33 billion per year for the two countries, and with other countries added in the total would probably surpass $50 billion. If First Americans had filed intellectual rights and asked for royalties of 1% of



gross, this would have yielded an income of $50 million per year.

Thank you indeed for these precious and worthy gifts, First Peoples!

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Dr. Francis R. Cook, author of the following article, has served as Curator of Herpetology at the Canadian Museum of Nature for over three decades, has contributed his services as Editor of the Canadian Field-Naturalist for fifteen years, and is the recent recipient of an award; ***Distinguished Canadian Herpetologist****, by the Canadian Association of Herpetologists, and made an Honorary Life Member of that Society. Dr. Cook is the Chair, Amphibians and Reptiles Subcommittee, COSEWIC; and Advisor to Canadian Scientific authority, CITES. He is author of that indispensable volume on Canadian herptiles,* ***Introduction to Canadian Amphibians and Reptiles.***

A national task force on frog declines in Canada

Francis R. Cook
Canadian Museum of Nature
P.O. Box 3443, Station D
Ottawa, Ontario K1P 6P4, Canada

As the last decade was ending, alarms began to sound that all was not well with the amphibian populations of the world. These vertebrates were soon heralded by some as possible "canaries" in the ecosystem: the class as a whole might be useful indicators of the seriousness of spreading biosphere degradation, and the cry was quickly taken up by the public media. The spread of concern also spawned symposia and discussion groups at several herpetological meetings. This, in turn, led to the **World Conservation Union** (IUCN), Species Survival Commission (SSC) activating a Declining Amphibian Populations Task Force (*see*: Declining amphibian poulations. **Biological Conservation Newsletter** Number 101, Smithsonian Institution, Department of Botany, National Museum of Natural History, Washington, D.C., September 1991).

Documented declines or even disappearances of amphibian populations have occurred in areas as far apart ecologically and geographically as the mountains of California and some arid regions in Australia. There are both cases of single attractive species like the Golden Toads in Costa Rica failing to breed in traditional breeding sites, as well as declines in whole suites of species in the same area for not clear and certain reason. David B. Wake of the University of California at Berkeley has assumed the role of the first Chairman of the IUCN Task Force, and has recently reviewed the evidence (1991. Declining amphibian populations. Science 253: 860). Even Wake, one of the most outspoken proponents of the reality and seriousness of the declines, admits that much of the contribution to date that is supportive of the hypothesis of a global factor in amphibian decline is anecdotal. The distribution of these scraps of data over the

world, however, could be indicative of something occuring that is much more than simply local habitat degradation. It is clear, however, that there is a primary need for more detailed and longterm objective measurement of populations.

Canada has only 42 or 44 (depending on whether you ask a "lumper" or a "splitter" in taxonomic philosophy) native species of amphibians, but many of them are widespread and abundant. They are an ideal unit for population monitoring and therefore for detection of any declines, if studied intensively. Canadian herpetologists have relatively quickly joined the international efforts. On the 5th and 6th of October 1991, a "Workshop on Declines in Canadian Amphibian Populations: Designing a National Monitoring System" was convened at the Canada Centre for Inland Waters in Burlington, Ontario, and attracted wide interest from specialists across the country. This meeting was organized and coordinated by Christine Bishop of **Environment Canada** and Bob Johnston of the **Metropolitan Toronto Zoo**, with their organizations providing support both for the meeting itself and for the attendance of distant contributors.

The first day was devoted to the presentation of a broad range of papers. These include the state of knowledge of amphibian populations across the country, presentations of data from individual monitoring studies, most still in progress, and those on specific topics such as parasites, contaminants, and habitat loss.

Christine Bishop and Bob Johnston provided introductory papers which set the tone and scope of the meetings. Jim Vial, the **IUCN** Task Force Coordinator, described the **IUCN** Declining Amphibian Task Force. They were followed by a series of presentations on the status of amphibian populations for most provinces individually: Stan Orchard (British Columbia), Carolyn Seburn (Saskatchewan), Wayne Weller (Ontario), Joel Bonin (Québec). Don McAlpine (New Brunswick), John Gilhen (Nova Scotia), Wayne Roberts (Alberta, given by Carolyn Seburn), and Bill Koonz (Manitoba). The morning finished with studies documenting declines in individual species or amphibians in general presented by Michael Oldham (Declines in Blanchard's Cricket Frog in Ontario), Michael Berrill (Bullfrog populations in Ontario), Christine Bishop (speaker), and J. Murray Spiers (Declines in amphibian populations in the Altona Forest, Ontario).

The afternoon papers began with techniques and interpretation of site monitoring studies: Michael Berrill (Results of monitoring amphibian populations in Central Ontario 1990-91), David Green (Status of Fowler's Toad, and amphibians of western U.S.A.), Roy McDiarmid (Standard methods for quantifying amphibian populations), Francis R. Cook (Pitfalls in quantifying amphibian populations in Canada), and Ronald Brooks (Monitoring wildlife populations in long-term studies). The remaining speakers emphasized approaches in specialized analysis within monitoring contexts: Bill Freedman (Monitoring ecosystem health), Jim Bogart (Monitoring genetic diversity in amphibian populations), Richard Wassersug (Factors affecting survivorship of larval amphibians), Graham Crawshaw (Diseases of amphibians), Christine Bishop (Monitoring the effects of contaminants on amphibians), and Bob Johnson (Monitoring habitat loss). Christine Bishop and Bob Johnson then presented a summing up to prepare the participants for the discussion session the following day.

Not surprisingly, the workshop presentations reinforced the need for intensive local long term studies. As elsewhere, Canadian trends are most often difficult to determine because of the lack of sufficient objective data. Because of their vocal conspicuousness in the breeding season, there is vastly more quantitative data on frogs than on salamanders. Some frog declines have clearly occurred. Blanchard's Cricket Frog, reliably recorded in Canada only on Pelee Island over the past 70 years, has

dropped from 20 documented localities on the island in the 1960's to a single population of very few individuals in the late 1980's. There are also declines in some frogs of the genus *Rana* in different parts of the country. In British Columbia and eastern Alberta, the Western Spotted Frog, *Rana pretiosa*, appears to be scarcer in the southwestern part of its range and perhaps also in the eastern portion. The Leopard Frog, *Rana pipiens*, once abundant on the prairies, seems to have been decimated in at least western Saskatchewan, southern Alberta, and the valleys of southeastern British Columbia. It has suffered great fluctuations in abundance in Manitoba as well. Bullfrogs, *Rana catesbeiana*, appear to have declined in areas in Ontario and breeding individuals may be smaller at some localities. No single factor, however, emerges as an uncontested explanation for any of the known declines, nor is it clear if they are irreversible. Among the causes that may be involved, habitat destruction, drought, and possibly overharvesting are implicated as the most likely. Potentially obscuring the data are the natural fluctuations within frog populations that may be irregularly cyclic, with climatic or other naturally occurring variations.

The second day was given over to the creation of working groups, defining their scope and objectives and finding leaders. At the conclusion of the day, the following volunteers were chosen:
Representatives for Canada on **IUCN** Task Force on Decline in Amphibian Populations -Bob Johnson, **Metropolitan Toronto Zoo.**
Task Force Coordinator for Canada - David Green, **Redpath Museum**, McGill University.
Regional Task Force Coordinators - Western Canada: Stan Orchard, **Royal British Columbia Museum**; Eastern Canada: Don McAlpine, **New Brunswick Museum.**
Provincial Task Force Coordinators - British Columbia: Stan Orchard; Alberta - Wayne Roberts, **Museum of Zoology**, University of Alberta; Manitoba: Bill Koonz, **Manitoba Department of Natural Resources**, and Wayne Weller, Mississauga; Québec: Joel Bonin, St. Lambert and Roger Bider, **MacDonald College** of McGill University; New Brunswick: Don McAlpine; Nova Scotia: John Gilhen, **Nova Scotia Museum.**

In addition five subgroups were also formed to follow-up specific areas of data on Canadian amphibians:
Historical Population Trends: Martyn Obbard, Fred Schueler, Wayne Weller, and Michael Oldham.
Intensive Monitoring Studies: Mike Berrill, Jim Bogart, Ron Brooks, Francis Cook.
Extensive Monitoring Surveys: Bill Freedman.
Environmental Contaminants: Christine Bishop.
Diseases: Graham Crawshaw.

A second workshop or a conference is already being planned for the fall of 1992, to be hosted by D. M. Green at the **Redpath Museum** at McGill University, Montreal, Quebec. A more extensive account of the first workshop, by Hinrich Kaiser, appears in the **Canadian Association of Herpetologists Bulletin** 5(2): 1-4 (October 1991). The Proceedings of this workshop, containing individual summaries of presentations, is scheduled for printing and distribution near the end of 1991 by Environment Canada and the Metropolitan Toronto Zoo. The **Canadian Association of Herpetologists Bulletin** has been chosen as the official news medium on the progress of working group. Dr. Green is its Editor. The **Bulletin** may be obtained by joining the Canadian Association of Herpetologists (annual membership $10). Application for membership and payment of dues should be forwarded to Dr. Patrick T. Gregory, Treasurer, CAH, Department of Biology, University of Victoria, Victoria, British Columbia V8W 2Y2.

A resolution in support of national conservation of biological diversity legislation and the establishment of a national center for biodiversity research

WHEREAS

The accelerating decline of biological diversity constitutes a significant problem for humanity;

The functioning of ecosystems and the quality of the environment are major concerns in achieving economic, technological and aesthetic goals;

There is a need for a coherent policy affirming the conservation of biological diversity as a high priority;

Biological information is critically important for an understanding and the conservation of biological diversity;

Collections of plant and animal specimens maintained by museums, universities, research institutes, and governmental agencies are an essential foundation for biodiversity databases and current and future biological research;

Government agencies, private conservation organizations, and citizens need biological and especially systematic and ecological information to meet their obligations to protect biological diversity;

Many biological survey activities in the United States, which are an important function of systematic biologists, are piecemeal, and there is little incentive for scientists and their institutions to perform such activities despite their importance to environmental policy;

Federal legislation has been introduced to establish a national policy for the conservation of biological diversity and a National Center for Biological Diversity and Conservation Research.

THEREFORE

The American Society of Plant Taxonomists supports the passage of national conservation of biological diversity legislation and the establishment of a national biological diversity strategy.

The Society supports a National Center for Biological Diversity and Conservation Research, which would function as a data coordination, information, and research funding center. The Society urges that this center be developed in coordination with other environmental and conservation databases, and encourages other scientists to support this and other initiatives that more fully incorporate biological information into the public process.

Passed by a vote of the membership of the American Society of Plant Taxonomists, 5 August 1991, in San Antonio, Texas.

NEWS

Who owns the human genome?
- US Patent Application for Genes

Work has been vigorously pursued on sequencing and mapping the human genome without concern about patenting the genes located (see other articles in last and present issue of *Canadian Biodiversity*). But on June 20th 1991, Craig Venter requested patents for 337 new human genes [*Nature* 353(6344): 485-486, 10 October 1991]. Venter obtained his data using robotic gene machines to sequence complementary DNA, or cDNA - the DNA that is actually expressed in an organism. The location of the genes is not mapped by this procedure and no information is provided about the function of the genes. Other scientists are protesting the patenting of such data, arguing patenting should apply to a knowledge of function or use. In other instances it is the variety of a plant or animal containing selected genes that is patented, not the gene itself. One can argue whether nature's inventions, single genes, should be patentable.

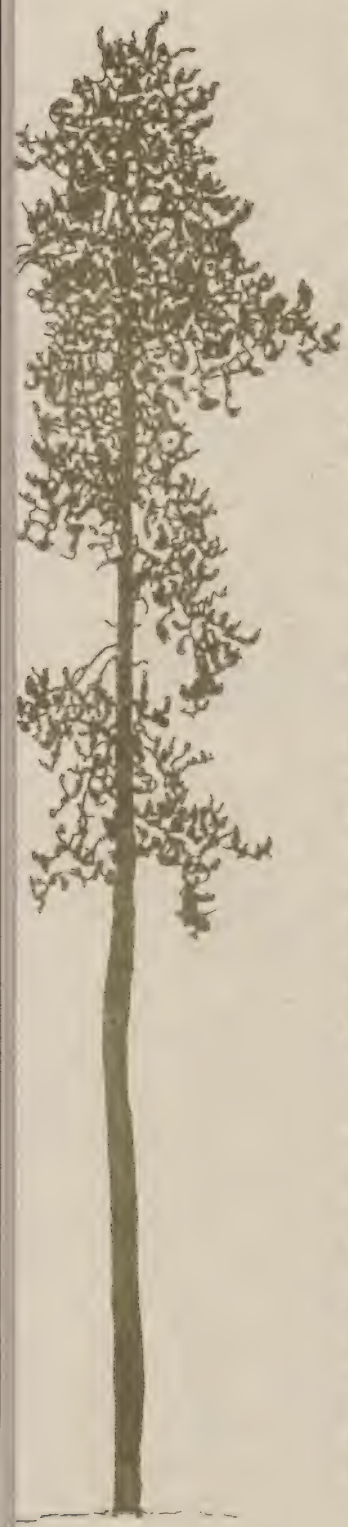
Venter argues that his approach is much cheaper and faster than the $3 billion Genome Project. This application will provide a big challenge to the U.S. Patent Office; there has already been great debate over the patenting of "new" varieties of crops and domestic animals. To other nations it poses the major socio-economic problem of whether the United States will "own" most of the human genome, and any other genomes of other species that the U.S. deciphers first.

Population pressure and the environment on the Earth Summit agenda

There is growing concern that the United Nations Conference on Environment and Development meetings, the Earth Summit, is ignoring the impacts of human population growth on biodiversity, forests and climate. The world population now stands at 5.4 billion, is growing at 93 million persons a year and will at least double before 2100 AD. The impact on the environment is high in developed countries because of their high rates of consumption and pollution, and high in developing countries because of encroachment on or over-exploitation of natural areas. The Royal Society of London and the National Academy of Sciences in Washington, perceiving a major omission from Earth Summit negotiations, are planning a joint statement of concern about environmental impacts of human population growth. A joint statement in February might be followed by an international conference in Stockholm. [Scientific American, January 1992, p. 32]. Unless the population issue is addressed, the Earth Summit agreements will be ineffective - each of the many human impacts on the environment is magnified by population increase.

Genetically increased food production

Genetic research begun in the 1940's has resulted in increases in the productivity of domestic animals and birds. The average number of eggs laid per year by hens has increased from about 120 in the 1940's to more than 320 by the 1980's. The average milk production per cow over a 305-day lactation period has increased from 2,000 kg in 1945 to more than 5,000 kg by 1980. Fifteen years of breeding and feeding regime changes have increase production in the Norwegian salmon industry by 60-70%. [*Naga, ICLARM Quarterly* 14(2): 11, April 1991).



Nitrogen availability and slash-burning of logged areas

Slash burning is commonly used to prepare logged-over sites in British Columbia for replanting. Slash burning has been shown to cause significant loss of nitrogen nutrient from the soil, and may lead to increased soil erosion and further nutrient loss. Studies by the Faculty of Forestry, University of British Columbia, suggest that severe burning increases nitrogen losses. Nitrogen losses can be minimized by burning when conditions are moist - when Drought Code or Buildup index values are low [J.W. and J.H. Fyles and M.C. Feller. 1991. Forest floor characteristics and soil nitrogen availability on slash-burned sites in coastal British Columbia. Canadian Journal of Forest Research 21: 1516-1522.]

Acid rain and growth of mycorrhizal fungi of jack pine

Many organisms are sensitive to the pH or acidity of their environment. The effects of acid rain on the rich diversity of organisms in soil has scarcely been studied. Some of these organisms, like mycorrhizal fungi, are very important to plant growth. These fungi conduct nutrients from soil water to the finer roots of plants. The health of forests and crops depend on these microscopic fungi. The question poses itself, therefore, to what extent are tree and plant die-offs in areas of acid rain due to impacts on these key fungi? Acid rain increases the amount of dissolved aluminum in soil water, relative to the amount of calcium. It has been suggested that calcium uptake can be blocked by aluminum. Experiments by Mark Browning and Thomas Hutchinson, Department of Botany, University of Toronto, found that increased aluminum concentrations reduced calcium in three species of these fungi and reduced magnesium and potassium concentration in two species. High aluminum levels elevated the precipitation of phosphates. It was concluded that anthropogenic alterations of calcium-to-aluminum ratios of soils may influence the succession of mycorrhizal fungi on tree root systems. Further, seedlings grown under high fertilizer regimes of commercial nurseries may become "infected" with naturally occurring fungi that are poorly adapted to the nutrient poor, acidic, high aluminum level soils of many reforestation sites. Survival of such seedlings might be enhanced by inoculation of more suitable fungi in the nursery. [M.H.R. Browning and T.C. Hutchinson. 1991. The effects of aluminum and calcium on the growth and nutrition of selected ectomycorrhizal fungi of jack pine. Canadian Journal of Botany 69(8): 1691-1699.]

Root fungus improves tree growth

Applications of myorrhizae, root fungi, to pine seedlings resulted in height increases of 34% and biomass increases of 50%. Similar results were obtained with tropical species such as Eucalyptus, dipterocarps, ipil-ipil and kakawate. Applications were made in tablet or capsule form. The fungi help the plant absorb water and nutrients from the soil. The experiments were carried out by the Philippine Council and Agriculture, Forestry and Natural Resources Research and Development/Department of Science and Technology (PCARRD/DOST). The cost of using mycorrhizae is less than the cost of using fertilizers. [Tao-Kalikasan, Newsletter of the Secretariat for an Ecologically Sound Philippines, 6(3): 2].

Natural pesticide from the Indian Neem tree

The Neem tree has traditionally been used as a safe source of insecticide in rural India. The International Rice Institute (IRRI) has discovered that Neem derivatives repel 123 species of insects, including those of stored grains. It controls the leaf miner which attacks vegetables and flowers, amongst other plants. The extracted insecticide is used as a foliar spray or soil drench. [Tao-Kalikasan, Newsletter of the Secretariat for an Ecologically Sound Philippines, 6(3): 3].

Diphtheria genes help relieve arthritis

Genes for diphtheria toxin, welded to a human protein using genetic engineering dramatically relieve symptoms of rheumatoid arthritis. The medicine, still in early stages of development, allowed one disabled woman to go dancing. The medicine seeks then destroys the variety of white blood cells that were erroneously destroying the lining of the joints. The medication is being developed by Seragen Inc., of Hopkins, Massachussetts. [Ottawa Citizen, p. A14, 6 May 1991].

Miracle cure for PCBs?

The U.S. Environmental Protection Agency (EPA) may have found a new, simple and fast way to dispose of polychlorinated biphenyls (PCBs). While preparing PCBs for incineration in the midwest, EPA found that they had chemically destroyed them. The quicklime that had been used to harden the waste sludge during cleanup produced a very hot reaction with the PCBs. This resulted in their molecular breakdown. PCBs are very stable and resistant to attack by most chemicals. [**American Fisheries Society** *Mainstream* 9(2): 4, September 1991, from **RCRA Review** 3(2), 1991].

Biodiversity Meetings

■ December 9-14, 1991. **Tropical Mountain Ecosystem Function**. This symposium, originally announced for July 1991, will be global in scope, highlight biodiversity and global change in America and Africa, and will be held at Papayán, Columbia. Information from A.M. Cleef, Correspondent for the Netherlands.

■ January/February 1992. **African NGOs Environment Network: NGO Preparatory Symposium on "African Environment - Towards sustainable management.** Venue to be announced.

Contact: ANEN
Tom M'Boya Street
P.O. Box 72421, Nairobi, Kenya
Tel. (254-2)747 960 or 740 817.

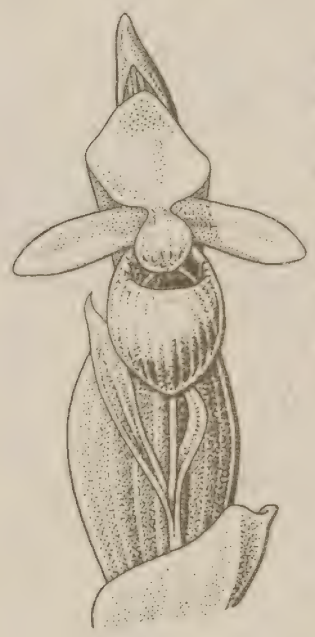
February 19-21, 1992. **Second International Zebra Mussel Conference**, Westin Harbour Castle, Toronto, Ontario, Canada.

Contact: Chris Brousseau
Zebra Mussel
Coordinating Office
P.O. Box 5000
Maple, Ontario L6A 1S9,
Canada
Tel:(416) 832-7273

■ March 16-20, 1992. **GLOBE '92**, at the Vancouver Trade and Convention Center, Vancouver, British Columbia.
Contact: Globe '92
250-1130 West Pender St.
Vancouver, B.C. V6E 4A4
Canada
Fax: (604) 681-1049

■ March 25-28, 1992. **Conference of the Society of Ethnobiology**, Washington, D.C., U.S.A.
Contact: Dr. Bruce Smith
Department of Anthropology
National Museum of
Natural History, Smithsonian
Institution
Washington, D.C., U.S.A.
Telephone: (202) 357-1572.

■ March 27-April 1, 1992. **Aquatic Biodiversity Session** at the 57th North American Wildlife and Natural Resources Conference, Radisson Plaza Hotel and Charlotte Convention Center, Charlotte, North Carolina, U.S.A.
Contact: L.L. Williamson
Wildlife Management Institute
1101-14th Street NW,
Suite 725
Washington, DC
U.S.A. 20005
Telephone: (202) 371-1808



■ June 1-12, 1992. ***The Earth Summit*, United Nations Conference on Environment and Development**, to be held in Rio de Janeiro, Brazil. The primary goal of the Summit will be to lay the foundation for a global partnership between developing and more industrialized countries, based on mutual need and common interests, to ensure the future of the planet. The Summit will be a conference of leaders of Government but its success will largely depend on the interest and support of peoples and their active participation in NGOs (non-governmental organizations) and citizens groups which will contribute to its preparations. Provision has been made for relevant NGOs to participate in meetings of the preparatory committee. A parallel event will be held by NGOs in Rio de Janeiro at the time of the Summit. Contact:

Secretariat,
United Nations Conference on Environment and Development (UNCED)
Case postale 80, Conches
Switzerland
Telephone: 41-22-789-1676
Fax: 41-22-789-3536

~ ~ ~ ~ ~

Book and Periodical Niche

Ecology and classification of North American invertebrates
Edited by James H. Thorp and Alan P. Covich. 1991. Academic Press, Inc., San Diego, New York, Boston, London, Sydney, Tokyo, Toronto. xii + 911 pages, illustrated. 28 x 21.5 cm. US$ 59.95. ISBN 0-12-690645-9.

The primary objective of this book is to present a general review of current knowledge on the ecology and classification of freshwater invertebrates, with emphasis on the species in Canada and the United States.

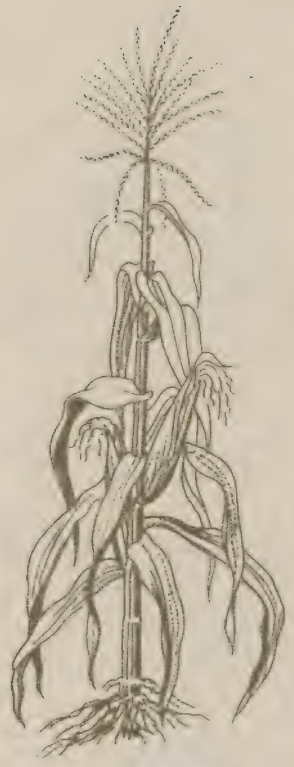
The first two chapters, **Introduction to freshwater invertebrates** and **An overview of freshwater habitats**, were written by the editors. The **Introduction** briefly introduces the approaches to taxonomic classification and provides synoptic diagnoses of phyla (and some classes) of freshwater invertebrates. The **Overview** examines the three types of freshwater environments, lotic (flowing waters such as rivers, streams, etc.), underground (hyporheic, phreatic and cave), and lentic (standing waters such as lakes, ponds, wetlands, etc.).

Each of the remaining 20 chapters deals with a phylum or class and is prepared by one or two authors who are the leading experts of the field in North American institutions. These chapters are usually subdivided into: introduction; anatomy and physiology; ecology and evolution; collecting, rearing, and preparation for identification; and classification or identification (with keys to North American freshwater invertebrates). Slight deviations from the general format is not uncommon because of the trend of studies in different taxa as well as personal interests of the authors.

The **Glossary**, **Taxonomic index**, and **Subject index** at the end of the book are well compiled. Readers will find it convenient to use these sections to locate further information in the book.

This book in many ways is similar to Pennak's **Fresh-water invertebrates of the United States** (2nd edition). The most significant contribution throughout this book, in my view, is the extensive and up-to-date reviews of ecology and physiology of the animals. They are informative and interesting. The literature cited is relevant and current. I checked several chapters and found that the references published since 1980 are usually significantly more than half of the total literature. This is probably a reflection of the recent progress in studies on invertebrate biology but is also an indication that the authors of this book have tried to keep us well informed of the current knowledge of the ecology and classification of freshwater invertebrates.

The editors are to be congratulated on keeping this multi-authored book in a reasonably uniform habitat and style of writing. Readers with some knowledge of biology will find it easy to read regardless of the high diversity of subjects and taxa it covers.



Except for a few line drawings that have broken lines or smudged ink and some photographic plates that are somewhat blurred, most illustrations are properly prepared and useful. The book is well checked and proofread but in a big volume like this some errors (typographic or factual) are bound to occur. Here are a few examples. The International Commission of Zoological Nomenclature is said to be a judicial body elected periodically by the International Congress of Zoology. In fact the latter has long been disbanded and the candidates for commissioners for the ICZN are nominated by scientists concerned with zoological nomenclature and voted by current ICZN commissioners. In **Bryozoa** (Chapter 14), the section of **Study methods** has a subsection of **A. Taxonomic key to species of freshwater bryozoans**. Are there subsections B, C, etc.? On page 787, the publication date of Copepoda H. Milne Edwards should be 1840, not 1984. On the same page, the author briefly mentioned the systematics of higher taxa of Copepoda. It should be noted that Caligoida, Lernaeopodida, and Notodelphyoida are not used by contemporary copepodologists (the first two under Siphonostomataoida, and the last under Cyclopoida).

In summary, this book, intended for non-experts, has successfully compiled up-to-date information on ecology, physiology and classification of North American freshwater invertebrates, especially the sections on ecology and physiology. I highly recommend this book for readers who are interested in the diversity of biological forms and functions. This is a must reference book for universities, biological research institutions and public libraries. It is an indispensable resource book on ecology and taxonomy of freshwater invertebrates for university students, researchers and informed laypersons in North America and elsewhere.

Chang-tai Shih
Canadian Museum of Nature
P.O. Box 3443, Station D
Ottawa, Ontario K1P 6P4, Canada

World resources 1990-91: A guide to the global environment.
World Resources Institute, in collaboration with the United Nations Environment and Development Programmes, Oxford University Press, 383 pp.
It is clear that, in order to change the way in which humans treat the earth, attitudes need to change and action must be taken. It is becoming apparent to environmentalists, however, that in dealing with environmental issues it is not enough to be well-meaning; one must also be well-informed.

The mandate of the World Resources series is "to meet the critical need for accessible, accurate information on some of the most pressing issues of our time." **World Resources 1990-91**, the fourth in the series, has been produced by the U.S.-based World Resources Institute, with the assistance of two departments of the United Nations: the Development Programme and the Environment Programme.

This large format paperback is divided into four parts:

- **Part I** summarizes, in a dozen pages, the environmental ills of the last decade

of the millennium. It uses a wide variety of phenomenal, from lead poisoning in Mexico City to drastic declines in the population of the African elephant, as examples of the crisis that is occurring in the Earth's biosphere.

- **Part II** is entitled Special Focus Chapters. The two chapters in this section examine in detail the issue of climate change, and gives an overview of conditions in Latin America.

- **Part III** reports on the status of major resource categories, examining areas of interest such as population, freshwater, and oceans.

- **Part IV** contains all of the supporting facts, and is composed of 120 pages of tables. Tabs along the sides of the pages connect these tables with textual information contained in Parts II and III, an innovative and useful form of referencing.

The text is well-written, and appears to make every effort to remain as objective as possible. For example, the chapter dealing with the controversial Greenhouse Effect is partitioned into two sections entitled Scientific Fact and Scientific Theory. This chapter is hung on its facts: its 19 pages contain 106 references to various sources of information. These pages are typical of the general tone of the book in that it strives to maintain an objective outlook: for example, it addresses not only the much-publicized causes of the Greenhouse Effect, ranging from the fertilization of plants by enriched concentrations of CO_2 to the role of oceanic water as a heat sink and CO_2 buffer. As with other chapters in this book, an important section entitled "Policy Options" suggests steps that can be taken by the human race to minimize their impact in this area.

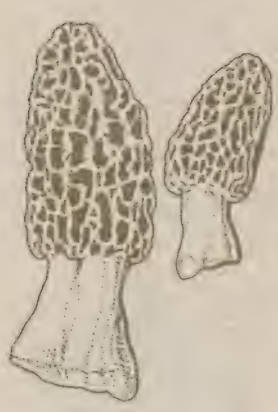
An important aspect of this book is that it does more than simply report on environmental and resource data; it offers an analysis of current conditions and trends, and proposes some solutions to the problems for policy makers and advocates. This book could be used by resource managers, scholars, teachers, students, public advocates, and policy makers: in short, by any concerned citizen who wishes to relate their own understanding and concerns to a global framework.

For an educator, **World Resources 1990-91** represents an immediate source of information about environmental problems that is reassuringly up-to-date. Unfortunately,the book's plethora of information and comprehensive nature may cause some educators to perceive it as intimidating, in the same way that the *Encyclopedia Britannica* is intimidating. The *Teacher's Guide to World Resources 1990-91*, was created to make World Resources more accessible and useful to teachers.

Gareth Thomson
P.O. Box 2225
Canmore, AB T0L 0M0, Canada

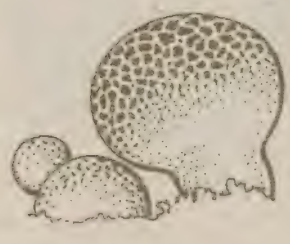
Deep-sea benthic biodiversity
By J. Frederick Grassle. 1991. BioScience 41(7): 464-469.
The ocean depths beyond the continental shelves support much greater biological diversity than has previosly been thought. New sampling showed deep-sea life was greater than that in shallow temperate waters and of the same order as collections from shallow tropical communities. The number of species of deep-sea biota may exceed 10 million species.

Three Men and a Forester
By Ian Mahood and Ken Drushka. 1990. Harbour Publishing, P.O.Box 219, Madeira Park, B.C.



This interesting book is part biography (the Ian Mahood story is presumably ghosted by Ken Drushka) and part exposé of the B.C. forest industry in cahoots with government public "servants". As an extra fillip the title poses a puzzle: find the Three Men and the Forester. The latter must be Mahood, while likely candidates for Men numbers one and two are H. R. McMillan (hero) and C. D. Orchard (villain). But who is the third Man?

In the evolution of Canadian forestry Hamish Kimmins of UBC recognized four stages: unregulated exploitation, administered forestry, ecologically based forestry and social forestry. He was optimistic that the '90s would usher in the fourth and final stage in which forestry is ecologically based, environmentally sound and able to satisfy the diverse needs of society at local , regional and national levels not only for wood but also for recreation, aesthetics and spiritual values: a fair statement of what the public *would like* forestry to be. Unfortunately, according to this book, British Columbia is still stuck in the primitive exploitation stage thanks to inept or crooked administrators and a politicized Forestry Service practising "sympathetic administration" on behalf of the corporations. Therefore Mahood has set his sights on a goal far lower than that of Kimmins. He would be happy to reach tne second stage: a forest well-administered to meet the long-term needs of the timber industry.



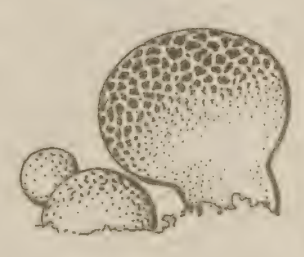
For more than forty years, says Mahood, we have been living with the flawed forest policy of the tenure system (the Tree Farm License System that alienates large blocks of public forest for exclusive industrial use). For the past 15 years that system has been manipulated by a small group of fixers employed by a handful of corporations owned and operated from a distance and, in terms of the welfare of our forests, by the most irresponsible government the province ever had. B.C. Forest Service statistics show that the value of a cubic meter of wood to the provincial economy actually declined by 8 percent between 8 percent between 1961 and 1987 as successive governments consistently underpriced the forest resource. In the latter year in B.C., net public revenue per cubic meter was only 2 cents, compared to $10.53 for the same amount of wood in the adjacent States. In short, the public has been consistently ripped off while the forests were slaughtered.

What to do? Mahood recommends placing control over forest administration under

regional land use boards that answer to the communities in each region, so that forests are managed to sustain the economies of the regions. Along with this reasonable measure he proposes separating the managers of the forest from those who use timber to manufacture products for sale around the world; that is, put trained foresters in charge of maintaining forests and sell logs in an open log market to those who process wood. Get the wood-product manufacturing industry out of the woods! Most of all, beware of the pulp and paper giants because, on the authority of H. R. MacMillan, they are potentially the ruination of the forest. They care not for forests and sizeable trees but only for what yields fibre; after they have creamed the forest, taking successively smaller and smaller trees, they will happily pulp match-sticks if that is what remains.

Despite its refreshing criticism of the *status quo*, this is an old-fashioned book, an out-dated book, a navel-gazing book. It speaks the tired language of utilitarianism, of unending exploitation, of competitiveness. Its aim is the same as in Gifford Pinchot's time 100 years ago: the efficient production of tree trunks and their industrial utilization. Mahood may know about wildlife and mushrooms and water and aesthetics but such things are unimportant frills. He does not talk about ecobiodiversity and biodiversity, about ecospheric processes and the effects of forests on global climate, about wilderness and old growth, about wilderness and old growth, about carbon storage and nitrogen cycling. He sings no hymns to forest beauty and inherent values. Like the anonymous "girl" referred to eighteen times in the first 80 pages, the forest as forest is just *there*, in no profounder sense than as backdrop for masculine enterprises of great pith and moment.

J. Stan Rowe
1012 Josephine Street
New Denver, BC
V0G 1S0



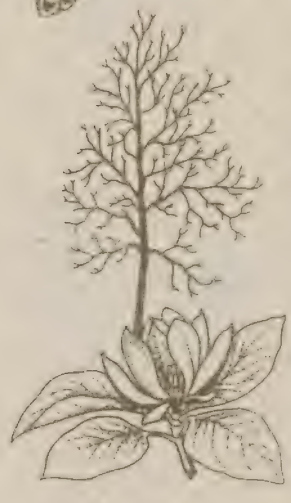
Wildflowers Across the Prairies

By F.R. Vance, J.R. Jowsey and J.S. McLean. 1991. Fourth printing of the 1984 revised and expanded edition, Western Producer Prairie Books, Saskatoon, Saskatchewan, 336 pp., CAN$22.95. Paperback. ISBN 0-88833-131-2.

It is a credit to the authors and publishers that this Canadian wildflower field guide is into its fourth printing. This showy, photographic catalogue of 400 of the most common prairie wildflowers is attractively laid out with colour photographs of one or more species per page, supplemented with line drawings. The texts follow a set format describing the flowers, fruits, leaves and growth habit using conventional botanical terminology. The introductory figures illustrating and naming plant parts or depicting variation in leaf, flower and fruit form, serve as useful aids, in clarifying plant structures. A glossary provides further explanatory definitions.

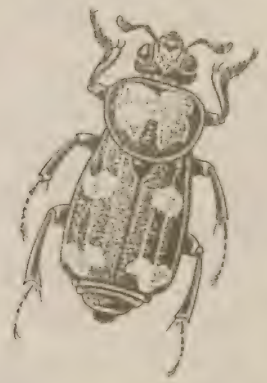
It would have been appropriate in this latest printing to eliminate some of the more evident errors of the 1984 edition. The upside down photos of fringed milkwort (p.

160) and that of the large photo of nodding beggarticks (p. 284) could have been corrected readily. Even more important corrections that should have been made include the replacement of the photo of fruiting "bittersweet" (*Celastrus scandens*) with a correct one of ("bittersweet", *Solanum dulcamara*) the actual species being described. The confusion caused by the use of the same common name for two unrelated species is reflected in this error. A similar error is found in the treatment of the nodding thistle (p. 285) where a photo of Russian-thistle (*Salsola pestifer*), a member of the goosefoot family, is included, erroneously, as an example of a true "thistle". The photo for perennial sow-thistle (p. 274) appears to be incorrect in that the distinctive glandular hairs found in the inflorescence of this species (*Sonchus arvensis*) are absent.



Occasionally, some photos are not mentioned or are improperly identified. A photo of sand cherry is included on page 118 without any mention of this species in the text. In the treatment of wild vetch (*Vicia americana*, p. 152), it is not made clear that the name tufted vetch appearing as a caption for one of the photos is actually *V. cracca* that is mentioned in the text.

If another revised edition were to be produced, some additional changes could be contemplated. The general ranges for each species should be given so that the prairie species could be distinguished from the more widespread North American species. Weeds should also be clearly identified. A number of photos that are out of focus or overexposed should be replaced, and some of the line drawings of flowers should be redrawn (e.g., p. 89, p. 138, p. 247) to improve their usefulness in clarifying flower structure.



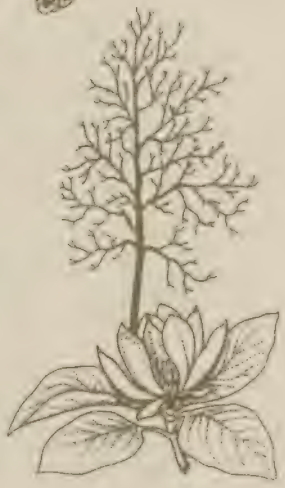
An update in botanical names, as for example, the use of *Platanthera* for *Habenaria* and of *Leucanthemum vulgare* for the ox-eye daisy, among others, together with some of the corrections and changes noted above, would do much to update this useful guide to the wildflowers of the prairies.

Erich Haber, Collections and Research Branch, Canadian Museum of Nature, Ottawa, Ontario.

A Cretaceous-Tertiary mass extinction? **Were most of the Earth's species killed off? By John C. Briggs. 1991. BioScience** 41(9): 619-624.
The K/T extinction was not as rapid or extensive as has been thought, nevertheless it took the world millions of years to recover its marine diversity. The world is now undergoing its first genuinely catastrophic extinction, extinction is taking place so fast that evolutionary response and ecosystem reorganization is impossible.

Global warming and prairie wetlands. Potential consequences for waterfowl habitat. By Karen A. Poiani and W. Carter Johnson. 1991. BioScience 41(9): 611-617.
Modelling predicts that greenhouse warming will cause a significant decline in habitat quality of semipermanent wetland on the Great Plains of North America.

Coarse woody debris dynamics in two old-growth ecosystems
By Mark E. Harmon and Chen Hua. 1991. BioScience 41(9): 604-610.
Dead trees are associated with many key functions in forest ecosystems. Because they may persist for centuries their influence is as long-lasting as that of living trees. During decomposition, logs and other forms of woody debris (wood more than 10 cm in diameter and 1 m in length) reduce erosion and affect soil development, store nutrients and water, provide a source of energy and nutrient flow, serve as seedbeds, and provide habitat for decomposers and heteromorphs. In addition coarse woody debris can store a large amount of carbon in forest ecosystems. These findings suggest the burning of woody debris following logging or the removal of debris for other purposes, should be rethought.



Earthkeeper, Canada's environmental magazine
Earthkeeper Magazine, P.O. Box 1649, Guelph, Ontario N1H 6R7, Canada. Telephone (519) 763-9357. ISSN 1181-7828. Subscription rates $24 + GST in Canada, US$30 in United States.

Earthkeeper, styled Canada's Environmental Magazine, reaches its second year of publication with the January/March 1992 issue. It is published six times a year. Special issues have covered solar energy, garbage, James Bay hydro projects, bioregionalism and native Canadians. Articles in the last two issues included darkroom chemical safety, kitchen composting with worms, organic farming, bioregionalism, the West Coast Burns Bog, the Moose River hydro development, comparison of native and non-native values, community land trusts, the Labrador Innu struggle, threat to a sacred MicMac site, women and the significance of water in Ojibway tradition, conflict between aboriginal philosophy and official tree farm regulation in B.C.

The articles are well-written, skilfully-edited and informative. Articles are complemented by Editorials, Letters to the editor, Profiles, Reviews, Perspectives (one on the B.C. logging debate written from the world's biggest clear-cut - 2,500 square kilometres), and Classified ads. Text is mingled with advertisements for environmentally friendly products. The design is pleasing and professionally done. The matte paper is recycled and vegetable oil printing inks are used. The cover is colored, the rest of the magazine is in black and white. The last two issues were 62 pages long.

If you want to keep up with environmental issues in Canada or learn about them, you should subscribe. I've just renewed my subscription.

Don E. McAllister, Editor

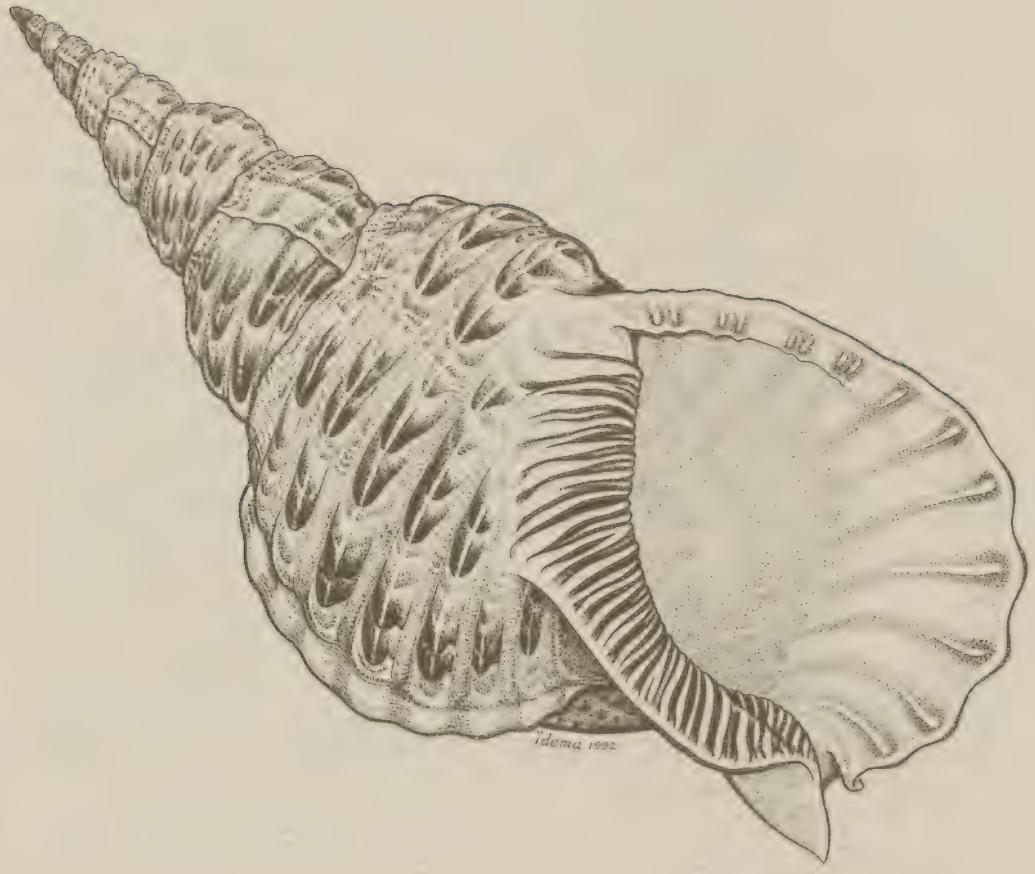


Illustration of ***Charonia tritonis***

Tritons (family Ranellidae, syn. Cymatiidae) are voracious carnivores mostly found in tropical seas. Their shells, prized by collectors, can reach large sizes (over 45 cm in length) and are strong, heavy and often with a colourful pattern. Shells of large specimens are used as horns (hence their name, Trumpet Shells); a hole is drilled near the apex and when blown, emits loud mournful sounds which can carry for miles. Most species live in or near coral reefs, feeding on echinoderms, including the Crown-of-Thorns sea star (*Acanthaster planci*), which feed on corals. It is thought that continuous overcollecting of large species of tritons over the past decades may have contributed to the current proliferation of the Crown-of-Thorns sea star and the rapid destruction of coral reefs in certain regions of the Indo-Pacific. More research is needed, however, to verify this idea.

NEWS FLASH!

$150 billion a year needed to save biodiversity and the environment

Maurice Strong, Secretary General of the U.N.-sponsored Earth Summit, says the world's wealthy countries may need to spend up to US$150 billion a year if they are serious about stopping environmental destruction [*Ottawa Citizen*, ca. January 18, 1992]. Despite some success stories, he stated that the global environment has continued to deteriorate. The Earth Summit will take place this June in Rio de Janeiro. There the main battle will be over cash and technological help for the Third World. Many Third World countries are so deeply in debt that needed conservation activities and infrastructure are difficult if not impossible. Yet Third World conservation contributes to survival of the whole planet. Strong applauded proposals for a tax on energy and carbon dioxide in the 12 European Community countries, saying it was good to see the EC countries taking a lead, but suggested that nuclear power generation should not escape the tax.

The Earth summit will include three conventions, one on forestry, climate and biodiversity. Divisions of a $150 billion fund amongst these three initiatives would probably leave biodiversity, the most all-embracing, complex and potentially rewarding initiative, with about half of the funding, some $75 billion.

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This world is but a single dewdrop
Set trembling upon a stem;
and yet...and yet..

Issa.

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